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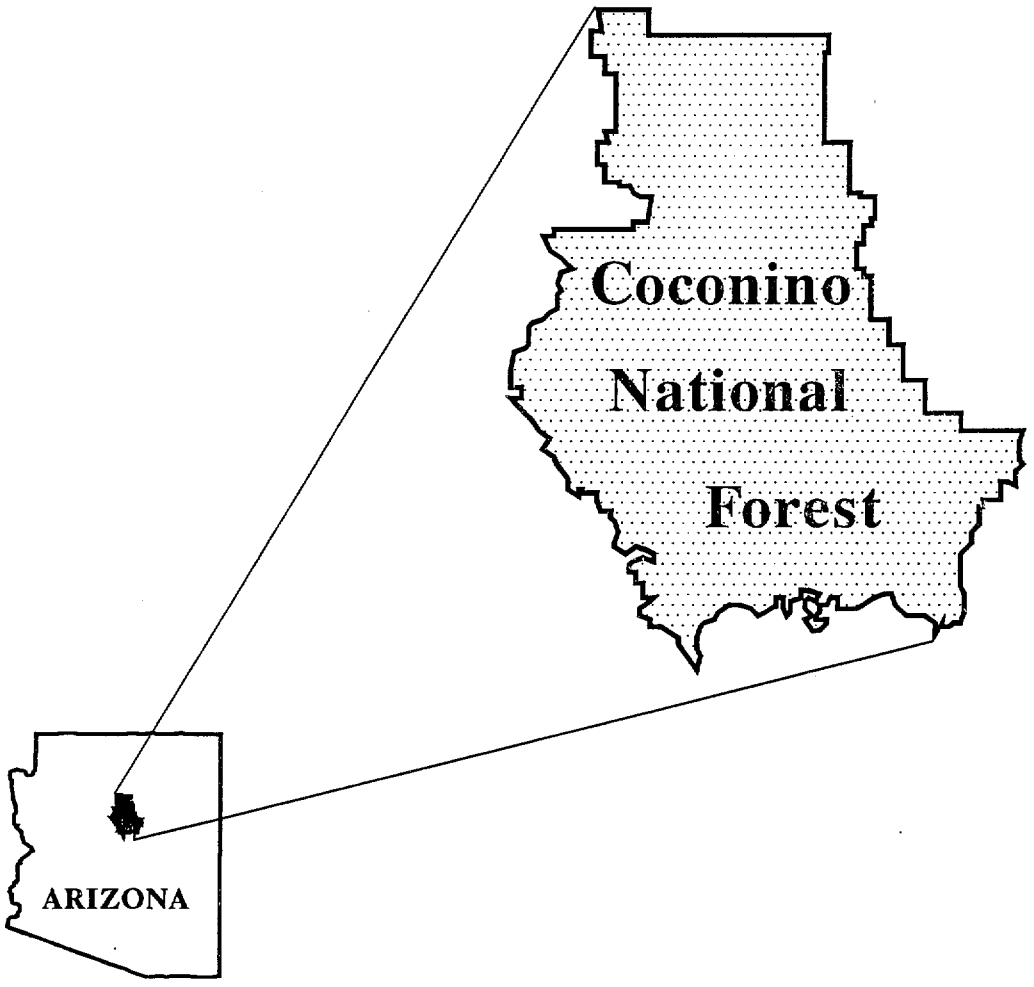
Mineral Land Assessment
Open File Report 1992

Mineral Resource Appraisal of the Coconino National Forest, Arizona



U.S. Department of the Interior
Bureau of Mines

MINERAL APPRAISAL OF THE COCONINO NATIONAL FOREST, ARIZONA

By

Michael E. Lane

MLA 11-92

Intermountain Field Operations Center
Denver, CO

UNITED STATES DEPARTMENT OF THE INTERIOR
Bruce Babbitt, Secretary

BUREAU OF MINES
Hermann Enzer, Acting Director

PREFACE

A January 1987 Interagency Agreement between the Bureau of Mines, U.S. Geological Survey, and U.S. Forest Service describes the purpose, authority, and program operation for the forest-wide studies. The program is intended to assist the Forest Service in incorporating mineral resource data in forest plans as specified by the National Forest Management Act (1976) and Title 36, Chapter 2, Part 219, Code of Federal Regulations, and to augment the Bureau's mineral resource data base so that it can analyze and make available minerals information as required by the National Materials and Minerals Policy, Research and Development Act (1980). This report is based on available data from literature and field investigations.

This open-file report summarizes the results of a Bureau of Mines wilderness study. The report is preliminary and has not been edited or reviewed for conformity with the Bureau of Mines editorial standards. This study was conducted by personnel from the Intermountain Field Operations Center, P.O. Box 25086, Denver, CO 80225.

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UNIT OF MEASURE ABBREVIATIONS

mt	metric ton
st	short ton
m	meter
oz/st	ounce per short ton
g/mt	gram per metric ton
km	kilometer
mi	mile
° C	degree Centigrade
in.	inch
ppb	part per billion
ppm	part per million
ft	foot
cm	centimeter
lb	pound
lb/cu ft	pound per cubic foot
g/cm^3	gram per cubic centimeter

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SCOPE OF STUDY

The U. S. Bureau of Mines conducted a study of the mineral resources, mineral exploration probability, and development potential of the Coconino National Forest. The U.S. Forest Service requested the study to provide it with mineral information to administer resources on forest service lands and to make decisions concerning land-use planning. Work included a field examination of the Coconino National Forest between 1989 and 1991.

SUMMARY

The Bureau of Mines studied the Coconino National Forest, Arizona, to appraise mineral resources and their development potential.

The Coconino National Forest is in north-central Arizona in Coconino, Yavapai, and Gila Counties. Most of the higher elevations are covered with volcanic rocks from the San Francisco and Mormon Mountain Volcanic Fields. The lower elevations, which encompass the Verde Valley, are primarily Mississippian- to Tertiary-age sedimentary rocks but also contain less extensive volcanics.

A total of 210 samples was taken during the field investigation; most were from small prospects or reported mineral occurrences. Several volcanic cinder samples were taken and

analyzed for possible gold content; no significant gold was detected in the fire assays. Two basalt samples were taken to determine suitability for road construction; abrasion tests indicated it is suitable for use in road construction.

Clay is found in the Verde Formation in the Verde Valley and at Rogers Lake near Flagstaff. Five samples were taken near Camp Verde and one sample was taken at Rogers Lake. Clay exposures in the Verde Valley are limited; drilling or trenching is needed to delineate any resources that may exist. An estimated 18 million mt [20 million short tons] of high-bloating clay exists at Rogers Lake. This clay possibly could be used in lightweight aggregate.

Limestone and sandstone samples were taken to determine suitability for industrial materials. The Redwall Limestone may be suitable for use in the production of cement; however, existing limestone resources exist near a cement plant, the primary user, and provides future needs.

The Coconino Sandstone is suitable for building stone (flagstone) but there are existing producing sites outside the National Forest near Ashfork. Sandstone from the Ashfork area is shipped throughout the U.S. and sells for about $95/ton; shipping is an extra cost.

Manganese (psilomelane) is found in the Long Valley area, where several occurrences have been reported. The manganese oxide mostly occurs as weathered-out nodules, although it was found in place in the Moenkopi Formation at one location. The manganese occurrences are small and no resources were identified.

Pumice occurs in the San Francisco Volcanic Field northwest of Flagstaff. The most prominent occurrences are at several surface excavations along the north forest boundary and at a producing mine just north of Flagstaff. Pumice resources could not be calculated because of the lack of exposure; only one locality had pumice in place. Pumice is used for stone-washed fabrics and in lightweight aggregate.

Uranium occurs in the Verde Formation east of Tuzigoot National Monument near Clarkdale. Samples were taken at trenches and pits containing sparse carnotite; the uranium content varied greatly. The lack of definable deposit boundaries, discontinuous occurrences, and overall low uranium concentrations preclude the estimation of resources.

Volcanic cinders are the largest resource in the Coconino National Forest; the Bureau has estimated that about 4.5 billion cubic meters of cinders exist. Most of the cinder cones with uniform grain size occur northeast of Flagstaff near Sunset Crater National Monument; however, well-sorted cinder cones also exist elsewhere. The current market seems to be supplied adequately with the cinder operations on private and state lands at and near Flagstaff.

Gypsum occurs in the Forest adjacent to a gypsum mine operated by Superior Mining on patented claims in the Verde Valley near the southwestern boundary. A gypsum sample taken in the Forest is low grade and beneficiation would be required to bring it to market

standards. Trenching or drilling would be needed to determine the extent of resources in the Coconino National Forest.

INTRODUCTION

The Coconino National Forest, north-central Arizona, comprises 737,159 hectares (1,821,495 acres) in Coconino, Yavapai, and Gila Counties. Most of the forest is in Coconino County; the western part is in Yavapai County and a small part along the south boundary is in Gila County. The forest extends from the Wupatki National Monument on the north to the Mogollon Rim on the south. The western boundary generally parallels the Verde River and the eastern boundary is generally along T. 9 E. The National Forest encompasses most of Townships 25-11 North and Ranges 3-11 East. The Coconino National Forest has headquarters in Flagstaff and is administered by six district offices: the Beaver Creek, Elden, Long Valley, Mormon Lake, Sedona, and Blue Ridge districts.

The largest town within the Forest boundary is Flagstaff, with a population of about 40,000. Sedona has a population of about 7,000, and Cottonwood has a population of about 5,000.

Road access to most of the forest is good. Interstate 40, which trends east-west and Interstate 17, which trends north-south, intersect at Flagstaff. U.S. Highways 89 and 180 extend north from Interstate 40 and U.S. Highway 89A extends south from Flagstaff through Oak Creek Canyon and into the Verde Valley; State Highway 87 provides access to the southern part of the forest.

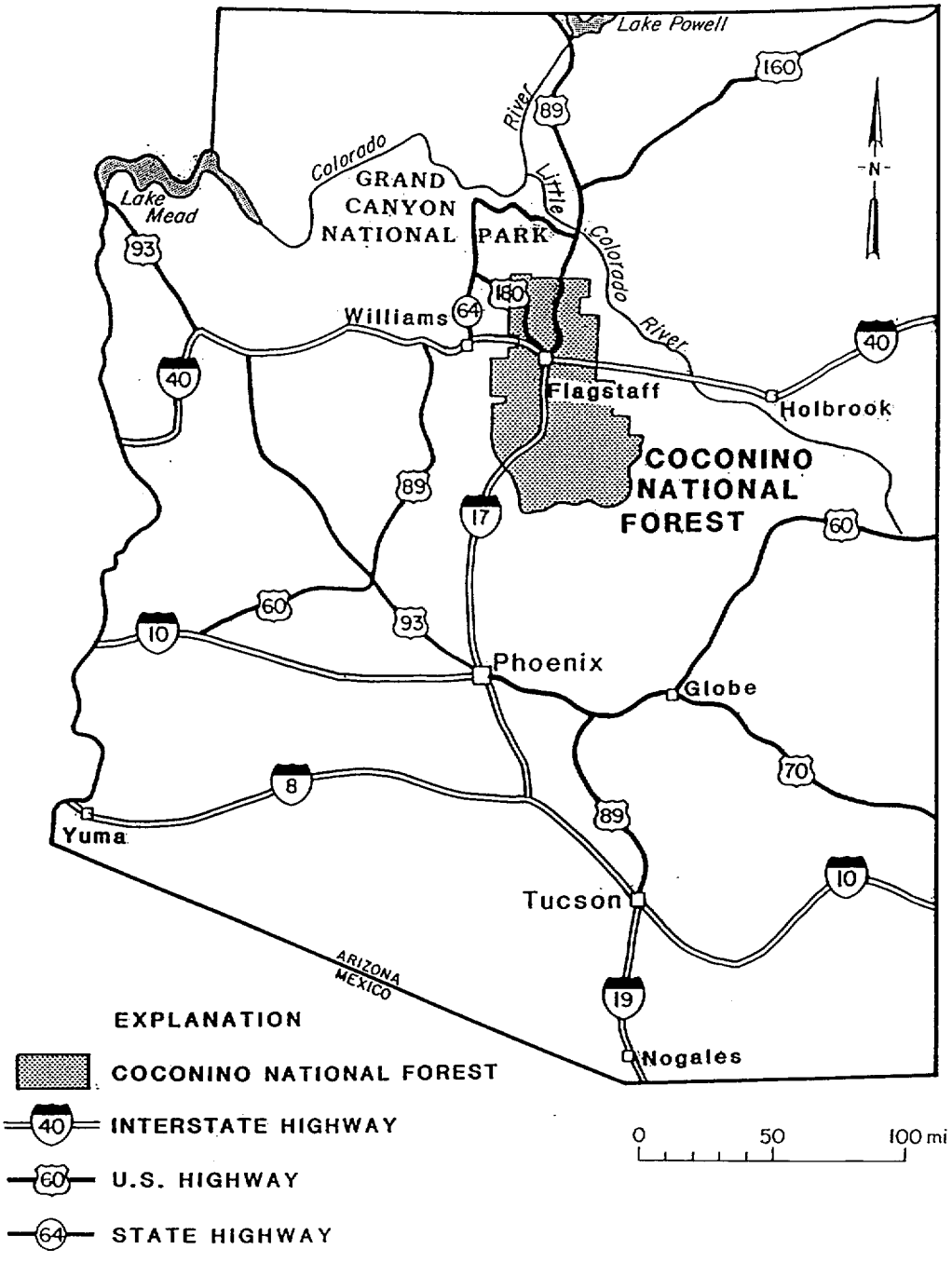

Figure 1.--Index map of the Coconino National Forest, Arizona.

Previous Investigations

Numerous masters theses and studies on geology and mineral occurrences in the Coconino National Forest have been produced at Northern Arizona University, Flagstaff. The Bureau of Mines (Bureau) and the U.S. Geological Survey (USGS) have conducted separate and cooperative studies on Forest Service lands that are in or adjacent to the National Forest: Sycamore Canyon Primitive Area (Huff and others, 1966), Wet Beaver Creek RARE II Further Planning Area (Bielski, 1982; Ulrich and others, 1983), West Clear Creek Wilderness Area (Ulrich and Bielski, 1983), Fossil Springs Wilderness (Weir and others, 1983), Rattlesnake Roadless Area (Munds Mountain Wilderness) (McColly, 1982; Karlstrom and others, 1983), Strawberry Crater Wilderness (Wolfe and Light, 1982), Mazatzal Wilderness (Ellis, 1982; Wrucke and others, 1983), and Arnold Mesa RARE II Area (McColly and Korzeb, 1981; Wolfe and others, 1983).

Methods of Investigation

Bureau personnel reviewed literature concerning mining, mineral occurrences, and geology of the region. Bureau of Land Management (BLM) records were reviewed to obtain information on patented and unpatented mining claim locations, oil and gas leases, and oil and gas lease applications.

In late 1989 and through the summer of 1991, Bureau geologists conducted a field examination of reported mineral sites in the Coconino National Forest. Field work, which was intermittent

because of seasonal weather conditions, was completed in the summer of 1991.

A total of 210 samples, mostly rock chip or grab samples (plate 1), was taken during the field investigation. Most samples were analyzed by inductively coupled plasma atomic absorption (ICP) for 32 elements[1] (Appendix A) by Chemex, Sparks, NV, and by neutron activation for 34 elements[2] including gold and silver by Bondar-Clegg, Lakewood, CO (Appendix B). Whole rock analyses were conducted on limestone and sandstone samples to determine suitability for industrial materials. In addition to ICP and neutron activation, cinder samples were fire assayed to determine the gold content because of recent interest in the reported occurrence of gold in cinders within the national forest. The detection limit for gold using neutron activation is 5 ppb (0.000146 oz/t) and the detection limit using fire assay is 0.002 oz/ton (0.07 g/mt). An LA abrasion test was conducted on two basalt samples to determine suitability for use in road construction. The abrasion tests were conducted by the Federal Highway Administration, Denver Federal Center, Denver, Colorado. Five clay samples were analyzed by the Alabama Mineral Institute, University of Alabama, Tuscaloosa, Alabama (Table 1).

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[1]Ag, Al, As, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, Hg, K, La, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Sc, Sr, Ti, Tl, U, V, W, Zn.

[2]Ag, As, Au, Ba, Br, Cd, Ce, Co, Cr, Cs, Eu, Fe, Hf, Ir, La, Lu, Mo, Na, Ni, Rb, Sb, Sc, Se, Sm, Sn, Ta, Tb, Te, Th, U, W, Yb, Zn, Zr.

Acknowledgements

The Bureau appreciates information on road materials supplied by Tom Foster, Greg Gentsch, and Ron Krohn of Arizona Department of Transportation, Flagstaff. C. T. Morgan of Arizona Tufflite, Inc., Phoenix and Ed Morgan of Arizona Tufflite Inc., Flagstaff, were helpful in supplying information on pumice near Flagstaff. The author wishes to thank Ed Davidson of Superior Mining in Camp Verde for his time and information concerning the gypsum and clay occurrences in the Verde Valley. Cliff Ayers of Phoenix Cement in Clarkdale was helpful in supplying information about limestone characteristics as they relate to the manufacture of cement. Ken Phillips and Nyal Niemuth of the Arizona Department of Mines and Mineral Resources were helpful in supplying information on mineral occurrences and industrial materials.

Mining history

Very little mining has taken place in the Coconino National Forest; current mining operations are relatively small and limited to cinders, basalt, and gravels near Flagstaff and gypsum near Camp Verde. Most other operations have been limited to small intermittent prospecting or excavating. Manganese, mined intermittently and on a small scale in the Long Valley area, is discussed in more detail later in this report. Cinders have been and are currently being mined near Flagstaff. Pumice has been mined along Highway 89 near the north forest boundary and is currently being mined about 16 km north of Flagstaff. Dimension stone has been mined from small quarries in Coconino Sandstone in

the Verde Valley and along the Mogollon Rim. Gypsum is being mined near Camp Verde from deposits in the Verde Formation. Basalt for road-construction has been removed from small quarries in the National Forest.

The Jerome mining district is west of the National Forest and has produced much gold and copper from the United Verde and United Verde Extension Mines near Jerome. The Verde Fault near Jerome is a major fault that, for the most part, is downthrown on the east side. Within the Forest, the Precambrian rocks are deeply buried.

GEOLOGIC SETTING

The Coconino National Forest includes part of the Colorado Plateau and the Transition Zone physiographic provinces. The National Forest can be divided into two distinct topographic areas: the higher plateau region (Colorado Plateau province) and the lower Verde Valley area (Transition Zone). The plateau region, which includes the southwest part of the forest, stretches south to the Mogollon Rim and is mostly capped with Pleistocene volcanics (plate 2). The lower Verde Valley area is underlain by sedimentary rocks, except for limited exposures of volcanic rock (Hinkey Formation).

With the exception of a small outcrop of Precambrian schist in the extreme southwest part of the forest along the Verde River, the National Forest consists of thick sequences of Paleozoic to Cenozoic-age sedimentary and volcanic rocks that range in age from Mississippian to Quaternary. Plate 2 is a generalized geologic map of the Coconino National Forest and was compiled from Arizona

Bureau of Mines (1958); Lehner (1958); Moore and others (1960); Ulrich and others (1984); Weir and others (1989).

The rock sequences in the Verde Valley indicate transgressing and regressing seas. Oak Creek Canyon was formed by erosion along a fault which has displaced the eastern rim of the canyon about 200 m below the west rim.

The San Francisco Peaks, the most striking geologic and topographic feature in the area, are the remnants of an ancient caldera in the San Francisco Volcanic Field. The field covers about 7,800 square km and has a lateral extent from the northern forest boundary to just south of Flagstaff and last erupted (Sunset Crater) about 1,000 years ago in Pleistocene time. The Mormon Mountain Volcanic Field stretches from just south of Flagstaff south almost to the Mogollon Rim.

Numerous cinder cones from strombolian eruptions and basaltic and andesitic flows characterize the San Francisco Volcanic Field. Sunset Crater National Monument, about 16 km northeast of Flagstaff, is a large cinder cone that erupted between about 1046 and 1071 A.D. (Colton, 1967, p. 36).

The sedimentary stratigraphic column from oldest to youngest age is: Martin Limestone, Redwall Limestone, Supai Formation, Coconino Sandstone, Toroweap Formation, Kaibab Limestone, Moenkopi Formation, Chinle Formation, and the Verde Formation. These formations have been described in detail.

Martin Limestone

The Devonian-age Martin Limestone is about a 140-m [450 ft] thick sequence of dolomite, sandstone, limy siltstone, dolomitic limestone, and limestone. The formation is uniformly bedded and forms ledges. It is darker in color at the bottom of the formation and also darker than the overlying Redwall Limestone. The Martin Limestone contains few fossils; any fossils that exist are commonly found near the top of the formation. The formation is considered to be Devonian in age. (See Lehner, 1958, p. 523-528.)

Redwall Limestone

The Mississippi-age Redwall Limestone is a massive, cliff-forming, light-gray to white limestone which crops out near the mouth of Sycamore Canyon, in small isolated outcrops near the mouth of Oak Creek Canyon, and at White Horse Hills north of Flagstaff. The limestone, which is about 70 m thick in Sycamore Canyon, is aphanitic to coarsely crystalline, fossiliferous, and unconformably overlies the Martin Limestone.

The limestone commonly contains solution cavities and caverns which may be collapsed or filled. These structures may be filled with limestone blocks and fragments that have been cemented.

Supai Formation

According to Lehner (1958, p. 537), the Supai Formation is about 490 m [1600 ft]thick in the Clarkdale Quadrangle and is about 670 m [2,200 ft] thick in the vicinity of Fossil Creek. It lies on an erosional surface on top of the Redwall Limestone.

The upper Pennsylvanian- and Permian-age Supai Formation is divided into the upper, middle, and lower members. The upper member is a 210-m [700-ft] thick sequence of sandstone that contains interbeds of siltstone; sandstone forms cliffs and pinnacles. The ratio of sandstone to siltstone is about 8 to 1. The medium- to coarse-grained, massively bedded sandstone is a reddish orange color, is generally friable, and forms sandy soil when weathered. The contact with the overlying Coconino Sandstone is indistinct. Both are cross-bedded and the lower part of the Coconino Sandstone blends with the Supai Formation. (See Lehner, 1958, p. 538.)

The middle member of the Supai Formation is about 90 m thick and generally forms broad flat areas with a few rounded hills. The principal rock is siltstone but pebble conglomerate, sandstone, and some limestone also occurs. Some siltstone beds are calcareous and contain chert nodules. Only about 25% of the middle member is conglomerate which is lenticular and grades into sandstone. The pebbles are between 1.25 cm and 13 cm in diameter; most are greater than 2.5 cm and well-rounded. The matrix is pink to reddish-brown siltstone.

The lower member is about 180 m thick and is composed mostly of sandstone and siltstone. Minor shaley mudstone, limestone, and chert breccia also occur. Characteristically, slopes are steep near the top of the member; slopes are more gentle near the bottom of the member.

Coconino Sandstone

The Permian-age Coconino Sandstone is an eolian sandstone of lower Permian age. It crops out along the Mogollon Rim and is found extensively in Oak Creek Canyon. The Coconino Sandstone ranges in thickness from about 120 m to 300 m [400 ft to 1,000 ft] (Weir and others, 1989). It is massive, cliff-forming, and is composed of homogeneous, light tan to white, fine-grained sandstone with striking crossbedding. The large sweeping crossbedding may be as much as 15 m [50 ft] long. It conformably overlies the Supai Formation (Lehner, 1958, p. 541).

Toroweap Formation

The lower-Permian age Toroweap Formation was originally described by McKee (1938, p. 12), who subdivided the Kaibab Limestone into the Toroweap Formation and the Kaibab Formation; the contact is sharp and easily recognized. The Toroweap-Coconino contact is conformable and sharp; the crossbedding of the Coconino is truncated by the horizontal beds of the Toroweap Formation (Lehner, 1958, p. 534-541).

Lehner (1958, p. 544) describes the Toroweap Formation in the western part of the forest as consisting of sandstone, calcareous sandstone, arenaceous limestone, siltstone, and some shale.

According to Weir and others (1989), the Toroweap Formation is a very-fine to fine-grained crossbedded sandstone. The formation, which merges with the Coconino Sandstone toward the south near West and East Clear Creek, is about 90 m [300 ft] thick.

Kaibab Limestone

Lehner (1958, p. 546) states the name Kaibab Limestone was changed from the Aubrey Limestone described by Gilbert (1875, p. 177). The lower Permian-age Kaibab Limestone is composed of sandy and silty limestone and dolomite (Weir and others, 1989). The Kaibab Limestone is locally cherty and fossiliferous. It unconformably overlies the Toroweap Formation. The maximum thickness is about 190 m [620 ft] near Blue Ridge Reservoir in the south part of the forest.

Moenkopi Formation

The lower Triassic-age Moenkopi Formation is composed of conspicuously reddish brown sandstone, mudstone, and siltstone beds. The Moenkopi Formation crops out mostly in the eastern part of the forest. The maximum thickness 120 m is along the eastern boundary of the forest about 16 km east of Mormon Lake.

Chinle Formation

The Coconino National Forest contains only small isolated outcrops of the upper Triassic-age Chinle Formation. Within the Forest, the formation crops out along the northern boundary about two miles east of Cedar Ranch; old stream channels and carbonaceous trash are present. A small exposure occurs just outside the eastern boundary near Yeager Canyon about 16 km east of Mormon Lake.

The Chinle Formation is composed of siltstone, sandstone, and mudstone. The formation is a common sight in northern Arizona, particularly on the Navajo Reservation where it comprises the

rounded knobs caused by erosion and weathering. It also comprises most of the Petrified Forest and Painted Desert National Parks.

The Chinle Formation is light gray to grayish-red and purple in color and commonly contains uranium occurrences. Weir and others (1989) state that the maximum preserved thickness is about 75 m [250 ft]. In the region, the formation may exceed 300 m [1,000 ft] in thickness.

Verde Formation

The Verde Formation is a lake bed deposit of late Tertiary (Pliocene) to Pleistocene age (Lehner, 1958, p. 561). Most of the formation includes fine-grained carbonate rocks including limestone, marl, calcareous sandstone, and limy siltstone. In addition, basalts and gravel deposits are interbedded with the fine-grained sediments.

The carbonate rocks are light-tan to white in color but may be pink or grayish. The limestone is hard, resistant to weathering, and is interbedded with sandstone, siltstone, and marl. Lehner (1958, p. 560) states that the sandstone is composed of rounded quartz and is fine-grained and calcareous, as are the siltstone and marl.

The Verde Formation contains salt, gypsum, and uranium deposits. Salt has been mined west of the town of Camp Verde but was not found within the National Forest during the field investigation. Uranium occurrences were found in the Verde Formation east and northeast of Tuzigoot National Monument.

Gravels most likely deposited as fans into the lake sediments

are interfingered with the carbonate rocks. The gravel deposits consist of coarse to fine gravel, sand, and silt of numerous rock types depending on location. (See Lehner 1958, p.560.)

The volcanics in the Verde Formation are olivine basalt flows. The absence of pillow structures may indicate that the basalt was deposited when the lake was dry (Lehner, 1958, p. 561).

Volcanic rocks

Two volcanic fields occur in the Coconino National Forest: the San Francisco Volcanic Field north of Flagstaff and the Mormon Mountain Volcanic Field south of Flagstaff (Billingsley and Hendricks, 1989, p. 69). The San Francisco Volcanic Field covers about 7,800 square km [3,000 square mi] in north-central Arizona (Robinson, 1913, p.9). During the study by Colton (1967, p. 2), 422 vents were listed and used to determine the volcanic history.

Volcanic rocks extend from the northern forest boundary southward to the southern edges of the Verde Valley. Although the volcanic coverage is not continuous, it is extensive (plate 2). Within the volcanic field, underlying sedimentary rocks are exposed only at Garland Prairie between Flagstaff and Williams, White Horse Hills, Slate Mountain, and Elden Mountain (Robinson, 1913, p.20).

Three main periods of volcanic activity occurred in the San Francisco Volcanic Field (fig. 2). Between these periods there was relatively little activity.

The first period was characterized by widespread lava eruptions from small cones and vents. Robinson calculated that 30 cubic miles of lava was extruded (see Robinson, 1913. p. 38-39);

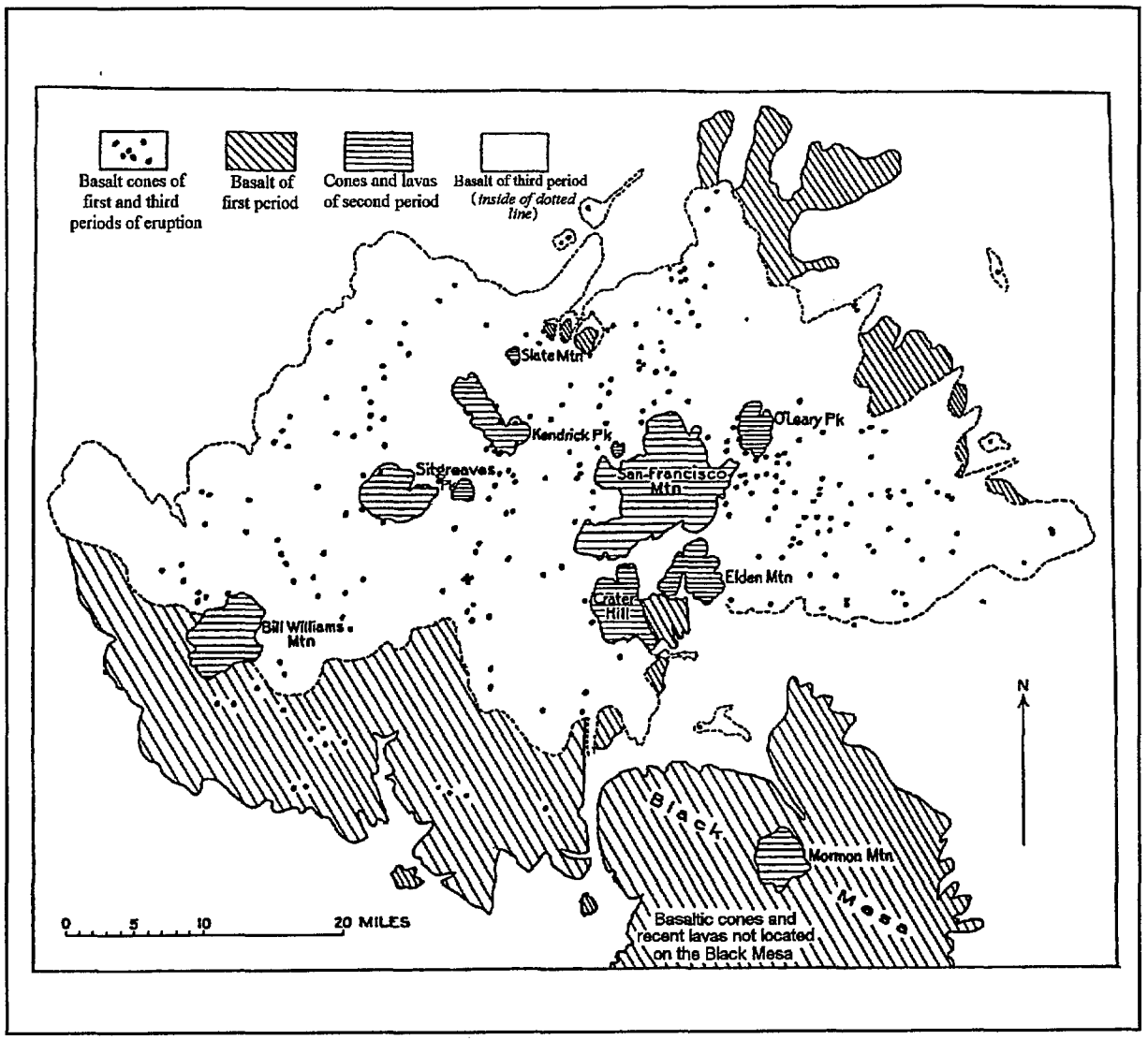

Figure 2.-- Sequence of volcanic events and distribution of cinder cones. (from Robinson, 1913)

however, Robinson may have included part of the Mormon Mountain Volcanic Field for his estimates.

In the second period, andesitic to rhyolitic lavas erupted and deposited large cones; the formation of the San Francisco Peaks, O'Leary Peak, Sitgreaves Peak, Kendrick Peak, Bill Williams Mountain (in the Kaibab National Forest to the west), and Mormon Mountain also occurred (Colton, 1967, p. 2-4). Laccolithic

activities were contemporaneous with the extrusions; the White Horse Hills (previously called Marble Hill), Mount Elden, and Slate Mountain were formed.

The third period was similar to the first in that a single lava (basalt) erupted. The period was further characterized by a less widespread distribution of lava and the formation of hundreds of cones. (See Robinson, 1913, p. 39; Colton, 1967, p. 4.)

COMMODITY APPRAISALS

Most of the mineral commodities of economic interest in the Coconino National Forest are non-metallic. Gypsum, sand and gravel, basalt, pumice, and cinders are the major commodities currently being mined. Arizona is second to Oregon in cinder production; most of the production in Arizona is from the Flagstaff area.

Basalt

Abundant resources of basalt (lava) are found in the plateau region of the Coconino National Forest. Numerous lava flows of the San Francisco and Mormon Mountain Volcanic Fields cover extensive areas of the plateau region and range from a foot to tens of feet in thickness.

The Arizona Department of Transportation (ADOT) uses basalt almost exclusively in the making of asphalt for road surfaces. In the past, cinders have been used in making asphalt but abrasion resistance was not high enough and it took much more oil to make the asphalt because of the vesicular nature of the cinders.

During this investigation two basalt samples were taken: one sample (62, sec. 2, T. 17 N., R. 6 E.) was from a flow at the top of Schnebley Hill Road and the other (59, sec. 8, T. 19 N., R. 7 E.) was from the road cut on the east side of I-17 at the Kelly Canyon interchange. Each sample was in excess of 25 kg and was crushed to 2 to 1 cm in size. LA abrasion tests were conducted on each sample to determine the hardness and resistance to abrasion, thus determining suitability as road material.

The test consisted of putting each crushed sample in a drum containing steel balls, turning the drum for 500 revolutions, and measuring the percent loss. The two basalt samples (samples 59 and 62) measured 26 and 27 percent loss, respectively. Acceptable loss for material used in asphalt for road construction is anything less than 40 percent (oral comm., Tom Foster and Greg Gentsch, Arizona Department of Transportation). In addition to abrasion resistance, basalt must be relatively free of clay seams, and from an economic standpoint, have little overburden and a flow thickness of at least 6 m. These localities, and probably many others, satisfy these criteria and the rocks are considered a resource. Drilling is needed to determine the exact thickness and extent of the basalt. A large part of the volcanic fields has rocks that could be used for road material.

Clay

Bentonitic clay has numerous uses depending on its physical characteristics. Clay is used as a foundry sand bonding agent, filtering, clarifying, and decolorizing oils (bleaching clays), in

animal feed, waterproofing and sealing of ponds and reservoirs, petroleum refining catalysts, drilling mud, pesticides and related products. Other uses include oil and greases adsorbents, paper coating and filler, and animal bedding. (See Peterson, 1987, p. 28.) Most of the clay found in the National Forest occurs in the Verde Valley; however, one clay sample was taken at Rogers Lake southwest of Flagstaff. The clays in the Verde Valley are in the Verde Formation and are bentonitic; the high-silica clay at Rogers Lake occurs in the lake bed and is probably the result of the weathering of the volcanics in the area (Minobras, 1975). Funnell and Wolfe (1964, p. 65) report that bentonitic clay in secs. 1, 2, 11, and 12, T. 13 N., R. 5 E., is low-expanding montmorillonite containing relatively high calcium.

Five clay samples were taken during the field investigation: sample 50 was from Rogers Lake bed and samples 182 and 184-186 were from the Verde Formation near Camp Verde. Analytical data for these samples are shown in Table 1. The clay from Rogers Lake is a montmorillonite-kaolinite that has a very high bloating factor and may be suitable in making lightweight aggregate. Samples 182 (sec. 29, T. 14 N., R. 5 E.), and 184, 185 (sec. 10, T. 13 N., R. 5 E.) are of clays that may be suitable for structural use such as facia brick, tile, etc. Sample 186 indicated clay that is below standards for industrial use (oral comm. Ken Phillips, Arizona Department of Mines and Mineral Resources).

The clay at Rogers Lake, secs. 31 and 32, T. 21 N., R. 6 E., and sec. 5 and 6, T. 20 N., R. 6 E., is in a deposit covering about

Table 1.-- Clay evaluation conducted by the Mineral Resources Institute on samples from the Coconino National Forest, Coconino County, Arizona.

[N/A, not applicable]

Sample Number:	50	182	184	185	186
Raw Properties:					
Water of Plasticity	23.2	27.5	25.0	24.1	23.3
Working Properties	Plastic	Plastic	Plastic	Plastic	Granular
Color	Gray	Tan	Tan	Gray	Tan
Drying Shrinkage (%)	7.5	7.5	7.5	5.0	7.5
Dry Strength	Good	Good	Good	Good	Good
Other Properties:					
Ph	7.8	8.0	8.0	7.9	8.1
HCL Effervescence	Negative	Negative	Negative	Negative	Positive
Other Test	N/A	N/A	N/A	N/A	N/A
Preliminary Bloating Test:	Positive	Negative	Negative	Negative	Negative

Bloating Test (Sample 50):

Temperature (°C/°F)	Percent Absorbance	Bulk Density (gm/cc)
1,000 / 1,832	52.2	0.89
1,050 / 1,922	38.2	0.72
1,100 / 2,012	32.2	0.51
1,150 / 2,102	Melted	

Table 1.-- Clay evaluation conducted by the Mineral Resources Institute on samples from the Coconino National Forest, Coconino County, Arizona.--Continued

Sample Density Number	Temp (°C)	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk Density gm/cc
50	1,000	5YR 6/6	5	12.5	7.8	16.2	2.09
	1,050				Melted		

Sample Number	Temp (°C)	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk Density gm/cc
182	1,000	5YR 7/6	5	10.0	23.0	38.3	1.66
	1,050	5YR 6/6	5	12.5	18.3	34.5	1.89
	1,100	5YR 5/6	5	12.5	14.1	27.9	1.98
	1,150				Melted		

Sample Number	Temp (°C)	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk Density gm/cc
184	1,000	2.5Y 8/2	3	5.0	44.8	58.5	1.30
	1,050	2.5Y 8/2	3	7.5	43.5	57.3	1.32
	1,100	2.5Y 8/2	3	7.5	43.2	57.0	1.32
	1,150	2.5Y 8/2	3	7.5	43.2	56.9	1.32
	1,200	2.5Y 8/2	3	10.0	35.3	51.3	1.45
	1,250				Melted		

Sample Number	Temp (°C)	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk Density gm/cc
185	1,000	2.5Y 9/1	3	7.5	29.4	45.4	1.54
	1,050	2.5Y 8.5/2	3	7.5	28.7	44.6	1.55
	1,100	2.5Y 8/4	3	7.5	28.7	44.6	1.56
	1,150	2.5Y 8/4	3	7.5	22.7	35.9	1.59
	1,200				Melted		

Sample Density Number	Temp (°C)	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk Density gm/cc
186				No Data			

280 hectares. Calculating the surface area of Rogers Lake and assuming an average thickness of about 3 meters, about 18 million mt of high-bloating clay could exist at Rogers Lake. Drilling or trenching is required to determine the exact thickness.

The clay at Rogers Lake is described by Guild (1910) as yellowish gray, very tough and plastic. A burning test on the clay using 100 parts clay to 300 parts limestone resulted in excellent quality cement. The composition of the clay was: 52.94 % silica (SiO_2), 17.91% alumina (AlO), 9.23% iron oxide (FeO), 1.22% lime (CaO), 0.42% magnesia (MgO), 2.22% alkalies, and 16.34% water. (See Guild, 1910, p. 82.)

Clay uses and characteristics vary greatly. Testing of the clay gives an indication of possible uses but is by no means absolute.

Diatomite

Diatomite is a light-colored siliceous sedimentary rock composed of the opaline cell walls of a diatom, a unicellular aquatic plant (Bates and Jackson, 1980, p. 173). Diatomite is used mostly as a filter aid. Other uses include filler in paper, molded plastics, and synthetic rubber, as a paint extender and flattening agent, and it is used in insulating applications. (See Bates, 1969, p.362.)

Long and Olson (1957, p. 94) report diatomite at an unspecified locality south of Camp Verde at elevations above that of the gypsum deposits; it is not known where the diatomite deposit is in relation to the Forest. A series of beds ranging in

thickness from a few inches to 2.5 m [8 ft] exist; many of the beds contain considerable amounts of calcium carbonate. The analysis of this occurrence from Long and Olson (1957, p.95) is: 86.64% SiO_2, 6.1% AlO, 0.22% Fe_2O_3, 1.91% CaO, 0.08% MgO, 0.11% NaO, 0.12% KO, a pH (50% slurry) of 8.10, oil absorption of 87.0 lb/100 lb, bulk density of 13.2 lb/cu ft, white color, a sintering temperature of 1149° C [2100° F], and the color of sintered crude is light pink. The diatomaceous material is "not of desirable quality for development" (Peirce, 1969, p. 341). Phillips (1987, p. 76) reports diatomite interbedded with gypsum, clay and calcium carbonate in sec. 16, T. 13 N., R. 5 E.; this occurrence is adjacent to, but outside the Forest.

Diatomaceous earth of unknown extent exists at the gypsum deposit currently being mined by Superior Materials about 6 km southeast of Camp Verde (oral commun., Ed Davidson, Superior Materials). No other diatomaceous earth occurrences were identified during the field investigation; however, the geology of the area is such that diatomite occurrences may exist in the Forest.

Gypsum

Gypsum (selenite) is a hydrous calcium sulfate with chemical formula $CaSO_4 \cdot 2H_2O$ composed of 32.6% lime (CaO), 46.5% sulfur trioxide (SO_3), and 20.9% combined water (H_2O). It occurs in sedimentary beds as an evaporite mineral formed by the evaporation of brines from ancient lakes or marshes, such as the lake that once covered the Verde Valley.

Gypsum is used in the making of portland cement to retard setting time, in agriculture for soil conditioning, and in the making of wallboard for the construction industry. When gypsum is heated to about 175° C it loses three fourths of the chemically held water. When mixed with water, the remaining material (calcined gypsum) is used as plaster. Gypsum plaster can be mixed with sand or perlite or other fine aggregate for use as an interior coating to lath, concrete blocks, or other backing. (See Bates, 1969, p.203.)

Gypsum within the Verde Formation is mined from a pit southeast of Camp Verde by Superior Mining Company. The material mined is about 70-75% gypsum and the rest clay. The material is washed to attain 93% gypsum, but varies between 85% and 93% gypsum. Between 45,000 mt and 54,000 mt is mined annually; about 36,000 mt to 41,000 mt is saleable. About 90% of the gypsum is screened to minus 2 in. and shipped to the Phoenix Cement Plant in Clarkdale. Screened product of minus 3/8 in. is used for agriculture and product of minus 1/8 in. is sold for home gardening use.

Gypsum was found only in the vicinity of the Superior Mine (T. 13 N., R. 5 E., secs. 1,2,11,12) during this investigation. Gypsum outcrops were found south of the mine and sampled; Superior Mining currently holds claims on these known gypsum occurrences. Reserves at the mine are estimated to be in excess of 200 years at the present mining rate. Significant gypsum deposits occur in the Forest adjacent to the existing mine. One sample (187) of gypsum was taken during the field investigation. The gypsum was

relatively compact and found between clay units. The analytical results (in weight percent) are:

Free Water	0.37
Combined Water	15.2
SiO_2 + insoluble	13.4
CO_2	.70
Fe_2O_3	1.20
Al_2O_3	2.10
CaO	26.6
MgO	4.0
SO_3	32.8
NaCl	<.04
Na_2O	.25
K_2O	.27
TiO_2	.11

Using the formula from Annual Book of ASTM Standards (1980, part 13, p.282), combined water (15.2 %) X 4.778 = purity of gypsum in percent (72.63 %), the sampled gypsum is considered low grade and would require beneficiation to bring it to marketable standards; however, the grade may vary within the deposit. Drilling or trenching would be needed to determine thickness, quality, and resources.

Limestone

Four limestone units crop out in the Coconino National Forest. The Martin and Redwall Limestones crop out near the mouth of Sycamore Canyon on the western edge of the forest. In the Verde Valley, the Verde Formation contains limestone units and the Kaibab Limestone is extensive in the southeast and central parts of the forest.

All limestone units were sampled and whole rock analysis was conducted to determine their composition. Results of the analyses are shown in Table 2.

The Phoenix Cement Company is mining Redwall Limestone about two miles west of the National Forest for use at its cement plant at Clarkdale. The mixture needed for cement is approximately 45% $CaCO_3$, 45% SiO_2, 2% FeO, 2% MgO, and 6% AlO, and gypsum; limestone provides the $CaCO_3$, SiO_2, and MgO needed for the manufacture of cement. The MgO is contained in dolomitic lenses within the Redwall Limestone. The alumina is supplied by volcanic ash adjacent to the Redwall Limestone. The volcanic ash must be low-alkali (K_2O plus Na_2O content less than 0.55%). If the volcanic ash exceeds 0.55% alkali, then bauxite, imported from Australia, is used as an alumina source. Clay-rich limestone within the Redwall Limestone supplies the needed silica. (oral commun., Cliff Ayers, Phoenix Cement Co.)

Gypsum is supplied by Superior Materials from the gypsum mine southeast of Camp Verde. Information on gypsum is discussed in greater detail in the gypsum section of this report.

The Redwall and Martin Limestones (samples 78-81) crop out in the lower end of Sycamore Canyon which is about 11 km from the Phoenix Cement Plant straight-line distance; distance on existing roads would be more. Some small Redwall Limestone exposures crop out north of Flagstaff in the White Horse Hills (sample 17), near Mount Elden, and in Oak Creek Canyon near Sedona.

Table 2.-- Whole-rock analyses for limestone samples from the Coconino National Forest, Coconino, Yavapai, and Gila Counties, Arizona.

Redwall Limestone

Sample	Al_2O_3	CaO	Fe_2O_3	K_2O	LOI	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	Total	BaO	Cr_2O_3	S total
17	0.09	61.7	0.05	<0.01	33.37	0.20	0.01	0.02	0.02	2.73	<0.01	98.23	0.002	<0.01	<0.02
78	0.25	63.6	0.13	<0.01	32.32	0.33	0.02	0.03	0.03	1.42	0.02	98.15	0.002	<0.01	<0.02
81	0.22	61.9	0.10	<0.01	34.13	0.28	0.02	0.03	0.04	1.15	0.01	97.93	0.004	<0.01	<0.02

Kaibab Limestone

Sample	Al_2O_3	CaO	Fe_2O_3	K_2O	LOI	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	Total	BaO	Cr_2O_3	S total
56	1.37	26.0	0.61	0.36	34.18	16.5	0.02	0.06	0.25	22.4	0.09	>101.9	0.010	<0.01	<0.02
61	1.35	25.9	0.38	0.40	36.00	16.2	<0.01	0.07	0.29	18.97	0.10	99.72	0.007	<0.01	0.02
207	2.17	15.4	0.46	0.60	21.82	9.87	0.01	0.04	0.44	49.84	0.14	>100.8	0.011	<0.01	0.02

Martin Limestone

Sample	Al_2O_3	CaO	Fe_2O_3	K_2O	LOI	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	Total	BaO	Cr_2O_3	S total
79	2.09	28.0	1.17	0.56	37.69	17.4	0.03	0.07	0.01	13.06	0.09	>100.2	0.006	<0.01	<0.02
80	1.95	28.7	0.95	0.50	40.42	18.1	0.02	0.04	0.04	9.42	0.08	>100.3	0.005	<0.01	<0.02

Verde Formation

Sample	Al_2O_3	CaO	Fe_2O_3	K_2O	LOI	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	Total	BaO	Cr_2O_3	S total
87	0.34	55.5	0.12	<0.01	39.91	0.74	<0.01	<0.01	0.13	0.62	0.01	97.37	0.027	<0.01	0.03
181	0.03	52.8	0.08	0.45	43.76	0.85	<0.01	0.06	0.14	0.42	0.01	98.50	0.03	<0.01	0.05
183	0.51	58.2	0.21	<0.01	36.62	0.76	0.02	0.04	0.02	2.16	0.03	98.62	0.006	<0.01	<0.02

Samples 78 and 81 are of Redwall Limestone from the lower end of Sycamore Canyon. Each sample contains low K_2O (<0.01%) and low Na_2O (0.03%). The CaO content of the samples is 63.6% and 61.9%, respectively. (See Table 2.)

Samples 79 and 80 are from the Martin Limestone which is, more accurately, a dolomite. The samples have relatively high magnesium contents, 17.4% and 18.1% MgO, respectively. The CaO content in the samples is 28.0% and 28.7%, respectively, much lower than the Redwall Limestone. The combined K_2O and Na_2O content is high, 0.63% and 0.54%, respectively (Table 2). This high K_2O-Na_2O content makes the Martin Limestone unattractive as material in cement manufacturing. The Redwall Limestone would be more suitable for cement; however, the remoteness of the area and the fact that it is in the Sycamore Canyon Wilderness makes development unlikely. Abundant supplies of limestone for the Phoenix Cement plant are located adjacent to the plant; roads would be needed if mining were to take place elsewhere. The other limestone in the area is in the Verde Formation which contains beds of limestone interlayered with siltstone, mudstone, and claystone. Three samples (87,181,183) were taken of the limestone units in the Verde Formation. The CaO content of the samples is moderate: 55.5%, 52.8%, and 58.2%, respectively. The combined K_2O and Na_2O contents are: <0.01%, 0.51%, and 0.04%, respectively. The chemical characteristics of the Verde Formation limestone make it suitable for use in cement; however, its distant location, the fact that it occurs interbedded with clay, mudstone, and siltstone, and the fact that Redwall

Limestone is readily available adjacent to the cement plant, make development unlikely in the foreseeable future.

Samples 56, 61, and 207 were of the Kaibab Limestone. Analytical data show that the Kaibab Limestone is very impure containing as much as 49.84% SiO_2 and 16.5% MgO making it unsuitable for anything other than road material and fill.

Manganese

Manganese oxide (mostly psilomelane) occurs at several localities in the southern part of the Coconino National Forest near Clints Well, about 96 km south of Flagstaff.

The Black Diamond and adjacent claims were first described by Jones and Ransome (1920, p. 125-128). From the descriptions in subsequent literature it appears that these claims were later incorporated into the McCloskey claims described by Wilson and Butler (1930, p. 56-59) and then into the Denison (W 1/2 sec. 30, T. 14 N., R. 10 E.) and Shoup groups (secs. 19, 20, 29, 30, T. 14 E., R. 10 E.) (Farnham and Stewart, 1958, p. 11). These deposits are generally referred to as the Long Valley deposits. In addition to the Long Valley deposits, the Blue Ridge (sec. 35, T. 14 N., R. 11 E.) and Lost Apache Claims (sec. 7, T. 13 N., R. 11 E.) are reported manganese occurrences further to the south.

Jones and Ransome (1920, p. 127) reported that manganese oxide (MnO_2) at the Black Diamond group (Denison group) occurred as replacement bodies near the surface in limestone or sandstone, as nodules and masses in decomposed limestone and sandstone, and as cement in breccia. The nodules and masses were found from the

surface to a depth of a few feet and were composed largely of psilomelane. Below the surface, the limestone has been partially replaced by MnO_2. The breccia contains fragments of sandstone and chert cemented by manganese and iron oxides. The ore is reported to have contained as much as 40 percent manganese. (See Jones and Ransome, 1920, p. 126-128.)

Farnham and Stewart (1958, p. 7) describe the deposits at the Denison Group as erratically distributed, small, irregular bodies in the Kaibab Limestone. Minor occurrences are found in the soil and alluvium. The ore bodies rarely exceeded 0.6 m [2 ft] in thickness and are disconnected and lenticular. Psilomelane and pyrolusite are the primary minerals; gangue consists or iron oxide and sandy limestone.

In the late 1920's, about 196 mt [216 tons] of manganese ore averaging about 45 to 48 percent manganese was shipped. In 1940, 181 mt [200 tons] containing as much as 40 percent manganese was shipped. Between 1940 and 1950, 1996 mt [2,200 tons] of ore averaging about 45 percent manganese was mined. In 1952 the property was leased to Bosley Mining Company of Flagstaff who built a jig plant at the south end of Mormon Lake. In 1952 and 1953 the company mined and concentrated several thousand tons of manganese-bearing soil and detrital material, in addition to 318 mt [350 tons] of sorted ore from the limestone. Total production through 1954 from the Denison property was about 3,357 mt [3,700 tons] averaging about 40 percent manganese. (See Farnham and Stewart, 1958, p.10.)

At the Shoup group, manganese occurrences are similar to those in the Denison group. Farnham and Stewart (1958, p. 10) reported that numerous pits, open cuts, and two shafts about 18 m [60 ft] deep were on the property. The shafts reportedly intersected 1.8- to 2.5-m [6- to 8-ft] zone of manganese ore at a depth of about 15 m [50 ft]. Production was about 544 mt [600 tons] of high-grade sorted ore which was mined during World War II.

The Blue Ridge claims, located in 1940, produced a few tons of sorted manganese ore in 1942. The ore was found as surface float and small lenses in decomposed, sandy limestone. Workings included a few open cuts in which small manganese lenses were exposed. (See Farnham and Stewart, 1958, p. 11.)

The Lost Apache claim was located in 1949; production consisted of a few tons of manganese oxide picked from the soil. Workings consisted of open cuts and pits in the soil. (See Farnham and Stewart, 1958, p.10.)

During the field investigation, five samples (samples 196-198, 203-204) were taken at the Shoup group and the Lost Apache property. Manganese oxide was found on the surface in the form of nodules as much as 8 cm in diameter.

Analytical results show that manganese content was as much as 46.9 percent (sample 204) from the Lost Apache occurrence. The manganese-oxide nodules are sparse and not considered a resource. Some samples contained significant manganese; however, the lack of significant quantities of manganese at these sites suggests that development in these areas is not likely. Drilling is needed to

Table 3.-- Manganese and Barium analysis of selected samples from the Coconino National Forest, Coconino and Yavapai Counties, Arizona. (Bondar-Clegg)

[na, not analyzed; values in percent]

Sample No.	Ba	Mn
14	na	1.22
28	na	1.43
193	na	10.62
194	na	31.20
195	na	40.80
196	na	16.03
197	na	20.00
198	2.34	37.39
199	na	0.18
200	na	0.19
203	2.41	41.15
204	2.75	46.90
205	na	44.30
208	na	0.11

determine if deposits exist in bedrock.

Pumice

Pumice is a silicic volcanic glass which is highly vesicular because of gases trapped during ejection from a volcanic vent. The average pumice contains 70.38% SiO_2, 15.82% Al_2O_3, 1.42% FeO, 1.50% Fe_2O_3, 1.56% CaO, 0.48% MgO, 3.70% Na_2O, 4.10% K_2O, and 3.62% loss on ignition (LOI) (Bates, 1969, p. 40).

Pumice is being mined on the Forest northeast of Flagstaff at the White Volcan property operated by Arizona Tufflite, Inc.. The deposit, which is relatively thick (more than 6 m), is unconsolidated and poorly sorted; individual cinders range from 0.5 cm to 15 cm in diameter.

The highest demand for pumice is in the garment industry to where it is used to produce "stone washed" fabric. Pumice is also used as light-weight aggregate in concrete, abrasives, landscaping, in household cleaners and soaps; finer grades are used for metal polishing. Pumice concrete is six times more resistant to the passage of heat; it is also more elastic and resistant to cracking or shattering than ordinary concrete. Crushed pumice is used in acoustic plaster and as loose fill in insulation, filters, soil conditioner, sweeping compounds, insecticide carriers, blacktop highway dressing, and poultry litter (Bates, 1969, p.41).

Pumice has been mined near Deadman Flat along the northern boundary of the forest. Reportedly, this pumice was used in concrete for Glen Canyon Dam near Page, Arizona. Three samples (24-26) taken in this area were analyzed by Jerry Hoffer, University of Texas at El Paso (table 4). Samples 25 and 26 were taken of pumice in place and sample 24 was a random grab of pumice on the surface (table 4). Samples 25 and 26 indicate a deposit that has material greater than 1.9 cm (3/4 in.) in a ratio that is marginal for use in the fabric industry; however, the remaining characteristics are good for use in the fabric industry and as light weight aggregate. Pumice in the Forest is sporadic in its

occurrence, making it difficult to determine resources without significant trenching and mapping.

Sandstone

Sandstone outcrops are extensive in the Coconino National Forest. The sandstone units are the Coconino Sandstone and the Toroweap, Moenkopi and Supai Formations. The Coconino Sandstone and the Supai Formation are the most prominent. Outcrops are extensive in the Oak Creek Canyon area and the Verde Valley. The Coconino Sandstone also crops out along the Mogollon Rim along the south boundary of the national forest and in the bottoms of major canyons.

The Coconino Sandstone is a wind-blown, well-sorted orthoquartzite. It has been quarried in the northwest part of the Verde Valley and along the Mogollon Rim for use as "flagstone." These quarries are small; there are no records of any production.

The Supai and Moenkopi Formations have been used as building materials. They are used as rock walls and in construction. The new library addition at Northern Arizona University incorporates sandstone from the Moenkopi Formation. The Moenkopi Formation has been used in several buildings in Flagstaff and northern Arizona as a building material e.g., the original buildings at the north end of the Northern Arizona University campus. The Supai Formation is also used as flagstone and rock facing. Currently, sandstone is being quarried near Ashfork by several companies. Flagstone sells for about $95/ton; delivery is extra. Flagstone is shipped all over the U.S. from these localities. It has been reported that the

Table 4.-- Analyses of pumice samples from the Coconino National Forest, Arizona.

[Analyzed by Jerry Hoffer, University of Texas-El Paso]

Sample No.	24	25	26
Location	T.25N., R.8E., SE sec. 32.	T.25N., R.8E., NW sec. 33.	T.25N., R.8E., NE sec. 28.
Surface fines (%)	0.3	0.7	0.4
Abrasion loss (-%)	0.7	3.3	0.9
Density (g/cm3)	0.65	0.57	0.69
Hardness (mm)	1.2	1.2	1.1
Porosity (%)	15	19	9
Impregnation Rate (g/min)	3.0	3.8	1.8
Size (weight % >3/4 in.)	40	11	3
Surface Coloration	Brown (> 10% FeO)	Light tan to light gray (< 1% FeO)	Light tan (<1% FeO)

sandstone in the Verde Valley is softer and less resistant to weathering than the sandstone near Ashfork, hence, making it less desirable (oral comm., Is Albright, Western States Stone Co., 1993).

In addition to building material, sandstone has optical, glass, filtering, and foundry applications. Glass sand usually requires a silica content of at least 93-99%, an FeO_2 content of 0.06% or less, and an Al_2O_3 content between 0.1% and 0.5%. Sand to

be used as foundry sand requires a SiO_2 content of at least 88%. (See Coope and Harben, 1977.)

Twelve sandstone samples were taken in the Coconino National Forest. Table 5 shows the analytical results of limestone samples. Table 6 shows characteristics and chemical requirements of silica sand for specified uses.

Based on the chemical compositions, the sandstones sampled in the Coconino National Forest are not suitable for any uses except possibly for foundry sand or decorative flagstone. All but two samples (179 and 201) are classified as protoquartzite (75 to 95% silica) (Bates, 1969, p. 98). Sample 179 (Supai Formation) had a silica content of only 69.72% and sample 201 (Moenkopi Formation) had a silica content of 59.13%.

All the samples taken had an Al_2O_3 content too high for most uses. In addition, Fe content was also high in most samples. It is concluded that the most important use for the Coconino Sandstone, and the Moenkopi and Supai Formations would be for building purposes such a flagstone or rock facing on walls, etc.

Volcanic cinders

The San Francisco and Mormon Mountain Volcanic Fields contain several hundred cinder cones and vents. Most of the cones are in the San Francisco Volcanic Field. The cinder cones vary in color from red to black, in texture from well- to poorly-sorted, and in cinder diameter between 0.5 cm and several cm. Most of the larger cones in the forest are in the vicinity of the San Francisco Peaks. The cones near Sunset Crater National Monument are black; however,

Table 5.-- Whole-rock analyses for sandstone samples from the Coconino National Forest, Coconino, Yavapai, and Gila Counties, Arizona.

Coconino Sandstone

Sample	Al_2O_3	CaO	Fe_2O_3	K_2O	LOI	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	Total	BaO	Cr_2O_3	S total
60	2.01	0.15	0.20	0.49	0.79	0.17	<0.01	<0.01	0.04	95.70	0.09	99.64	0.005	0.01	<0.02
65	2.24	0.05	0.51	0.73	0.68	0.08	<0.01	0.03	0.01	94.60	0.09	99.02	0.010	<0.01	<0.02
73	3.24	0.12	0.79	0.58	1.13	0.12	0.18	0.03	<0.01	93.89	0.20	>100.2	0.019	<0.01	<0.02
76	3.25	0.34	0.45	1.08	1.05	0.15	<0.01	0.04	<0.01	95.13	0.11	>101.6	0.019	<0.01	<0.02
190	1.85	0.08	0.52	0.45	0.95	0.10	<0.01	0.03	0.05	94.60	0.06	98.70	<0.01	0.01	<0.02
191	2.63	0.03	0.54	0.75	1.26	0.12	<0.01	0.05	0.07	92.8	0.17	98.44	<0.01	0.02	<0.02
206	1.81	0.19	0.31	0.22	0.58	0.09	0.06	0.02	<0.01	94.38	0.06	97.72	0.008	<0.01	<0.02

Supai Formation

Sample	Al_2O_3	CaO	Fe_2O_3	K_2O	LOI	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	Total	BaO	Cr_2O_3	S total
68	3.78	0.38	0.92	1.31	1.04	0.11	0.01	0.03	<0.01	93.55	0.16	>101.2	0.017	<0.01	<0.02
69	6.96	1.58	1.85	2.82	3.20	1.08	0.04	0.07	0.07	81.65	0.49	99.81	0.028	<0.01	<0.02
179	4.43	6.71	1.20	1.88	10.76	4.52	0.03	0.08	0.04	69.72	0.31	99.68	0.024	<0.01	<0.02

Toroweap? Formation

Sample	Al_2O_3	CaO	Fe_2O_3	K_2O	LOI	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	Total	BaO	Cr_2O_3	S total
77	3.30	0.92	0.82	1.46	0.80	0.40	<0.01	0.03	0.07	91.30	0.20	99.30	0.015	0.02	<0.02

Moenkopi Formation

Sample	Al_2O_3	CaO	Fe_2O_3	K_2O	LOI	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	Total	BaO	Cr_2O_3	S total
201	7.36	13.4	2.11	1.54	13.01	0.38	0.09	0.07	0.12	59.13	0.55	97.82	0.029	<0.01	<0.02

Table 6.-- Some general specifications for silica/quartz by end use. (Taken from Coope and Harden, 1977, p. 16)

[All units are in %; EV, extremely variable; V, variable 0.1-0.5; na, not applicable]

End Use	Min SiO_2	Max Al_2O_3	Max Fe_2O_3	Max CaO/MgO	Remarks
Glass sand					Must be <6 ppm Cr and <2 ppm Co, 0.01-0.05% TiO_2, constant grain size and purity.
Optical	99.5	V	0.008	na	
Colorless	99.5	V	.013	na	
Container/flat	98.5	V	.030	na	
Foundry sand	88-99	EV	EV	EV	Chemical composition variable, 98-99% SiO_2 preferred.
Silica flour	97-98	0.5	0.2	na	Micron size grains.
Silicon carbide	99.5	0.6-.25	0.1	absent	No P allowed, 0.25% Al_2O_3 sand for black SiC, 0.1% for green SiC.
Silicon	98.0	0.4	0.2	0.2	No P or As.
Ferrosilicon	96	0.4	0.2	na	0.1% P maximum.
Silica brick	96-98	0.1	na	low	None
Sodium silicate	99	0.25	0.03	0.05	Basically same as glass-grade sand
Silica flux	90	1.5	1.5	0.2	None

red to rust-colored cones also exist in the vicinity.

Currently, cinders are being mined at numerous localities near Flagstaff on private and state lands. Cinders are widely used in the construction industry as fill and surfacing material, as a sanding agent on snow and ice, in the making of cinder block, in gas barbecue grills, and in underlayment and light road repair. Most of the cinders used in the making of cinder block come from Merriam Crater northeast of Flagstaff (oral comm., Wally Smith, Block Lite, 1990).

The making of cinder blocks requires sand, cement, cinders, and fly ash. The sand for Block Lite's operation comes from the Gray Mountain area; the cinders are from the Merriam Crater area.

The cinders are black, well sorted, and somewhat homogeneous in nature (no welded material) (oral comm., Wally Smith, 1991, Block Lite).

In general, the cones that are being mined are poorly sorted and require screening. Phoenix is usually the greatest distance the cinders are shipped because of transportation costs.

A relatively recent and somewhat controversial interest is reported gold occurrences in volcanic cinders near Flagstaff. It has been reported that gold occurs in and can be extracted from volcanic cinders at certain localities in the San Francisco Volcanic Field.

Two such properties were described in unpublished reports in files at the U.S. Forest Service and the Arizona Department of Mines and Mineral Resources. The Cinder Mountain Project is a cinder cone located about 40 km northeast of Flagstaff. An unpublished report describes gold occurrences and possible recovery of gold from mining claims in sections 19 and 20, T. 22 N., R. 10 E. The Bureau of Mines took three samples (43-45) at this cinder locality; samples were fire assayed for gold and results showed gold concentrations less than the 0.002 oz/st (0.07 g/mt) detection limit.

Another report prepared for Cimarron Corporation/Mariah International by Baki Yarar , Colorado School of Mines, Golden, CO, titled "Analysis of Cinder Cone Materials" CSM Project No. 2522/4-49044, describes analyses of cinder samples submitted to the Colorado School of Mines. The samples were collected from five

localities about 48 km northwest of Flagstaff. Only two samples were from the Coconino National Forest; the remainder were from the Kaibab National Forest. These two samples were from a cinder pit shown on the Kendrick Peak Quadrangle in the NW sec. 6, T. 24 N., R. 6 E.(Forest Service files)

The analytical procedures described in the report by Baki Yarar are not presented at this time; however, the analytical results of the two samples taken within the Coconino National Forest were 9.2 ppm (0.27 oz/st, 9.2 g/mt) and 5 ppm (0.15 oz/st, 5 g/mt) gold (Yarar, 1987, p. 7). The Bureau of Mines took one sample (3) at this locality; fire assay of the sample showed the sample contained <0.002 oz/st (0.07 g/mt) gold.

The Bureau took 43 samples of volcanic cinders during the field investigation that were analyzed for gold by fire assay (lower detection limit 0.002 oz/st) and neutron activation methods (lower detection limit 5 ppb) by Bondar-Clegg, Denver, CO (Appendix B). Only two samples were above 6 ppb gold; using fire assay, sample 51 contained 10 ppb (0.000292 oz/st, 0.343 g/mt) and using neutron activation, sample 41 contained 140 ppb (0.0041 oz/st, 0.14 g/mt). Based on these results, no gold resources exist in the Coconino National Forest.

From Bureau of Mines' calculations it is estimated that cinder resources in excess of 4.5 billion cubic meters exist in the Coconino National Forest. These calculations were done by determining the total volume of about 90 cinder cones in the San Francisco volcanic field. These resources do not distinguish the

color and sorting properties that different cones exhibit, but are meant to give an idea of the amount of resource that exists. Cinder cone localities are shown on plate 1. Development of the cinder resources would depend on market criteria such as future market demands, mining costs, Forest Service regulations and permit procedures. At present, the supply of cinders is adequate to meet the demand.

Sand and gravel

Sand and gravel deposits are found in most drainages in the Verde Valley; the glacial outwash from the San Francisco Peaks is being mined northeast of Flagstaff. The Verde Valley area contains numerous deposits of sand and gravel in drainages and tributaries; most of the larger deposits occur along the Verde River. Environmental restrictions limit the number of these deposits that may be mined. Isolated gravel deposits exist in pockets throughout the Verde Valley. Most sand and gravel is being mined from private land; development on Forest land is mostly determined by environmental and Forest Service concerns.

Miscellaneous occurrences

Sodium sulfate deposits occur and have been mined outside the National Forest, west of Camp Verde, by Western Chemical Company. Sodium sulfate is used primarily in the production of kraft paper pulp. Deposits are evaporite type and occur as the result of accumulation and evaporation of solutions in closed basins or lakes. The sodium sulphate is pure anhydrous sodium sulfate occurring in solid crystal form. The deposit consists of about 46

m [150 ft] of alternating beds of thenardite, clay, and other sodium salts (Weisman and Tandy, 1975, p. 1085). Sodium salt (NaCl) associated with and usually below gypsum possibly could be found throughout the Verde Formation . No salt occurrence or deposit was found during this investigation.

Travertine is a calcium carbonate deposited from warm ground water solutions that have percolated into fractures and voids in the host rock. Impurities, such as iron, result in colorful banding and make travertine popular in art and crafts. Travertine is found in the National Forest in small veins near Lake Mary, in Long Valley, and isolated areas in the Verde Valley. Deposits are small and development would be limited to small operations.

ENERGY RESOURCES

Exploration for oil and gas occurred in the Oak Creek and Mormon Lake areas in the 1960's. Twenty-eight wildcat exploration holes were drilled; however, there was no indication of hydrocarbon fluids.

Recent (geologically) volcanic activity near Flagstaff (San Francisco and Mormon Mountain Volcanic Fields) suggests that a significant heat source lies beneath the surface. The San Francisco Peak area is classified by the USGS as prospectively valuable for geothermal steam.

Geothermal waters near Montezuma's Castle and at the Verde Hot Springs are 30° C to 40° C. It is estimated that temperatures of 233° C to 277° C may exist (Tellier, 1973). Temperature gradient holes are needed to measure temperatures, depth, extent of

geothermal activity, and to determine boundaries of temperature stability.

The Verde Formation east of Tuzigoot National Monument forms buttes that contain isolated uranium occurrences. The area has been intensely investigated for uranium as evidenced by numerous workings and bulldozer cuts in the buttes. It is reported that Kerr-McGee Corporation drilled several shallow holes in this area in search of uranium (Forest Service files, Beaver Creek Ranger District). Kerr-McGee offices that at one time contained information concerning this area have since been closed.

Carnotite, a uranium vanadate $K_2(UO_2)V_2O_8 \cdot 3H_2O$, was found during the field investigation at various localities but was by no means extensive. It occurs as yellow coatings along fractures, usually in the white to gray mudstones. Scintillometer readings were taken at all the workings investigated; readings were from background to several times background amounts and give an indication of where to sample. Data are shown in Table 7.

Approximately 90 uranium workings were sampled (samples 82-178). (See plate 1.) The workings were small pits or bulldozer cuts; no underground workings or workings that may have resulted in production were found. Finch (1967, plate 1) suggests that less than 900 mt [1,000 tons] of uranium ore of 0.1% or more U_3O_8 was produced.

The highest uranium content from Bureau samples taken in this area (82-178; figure 3) was 150 ppm (0.015 percent). The sporadic nature of the carnotite occurrences, overall low uranium

concentrations in samples, and the depressed uranium market indicate that development of uranium resources is not likely under current conditions.

CONCLUSIONS

With the exception of clay, mineral resources are determined by exposures of a particular geologic unit which contains the resource or is a commodity by itself such as the Coconino Sandstone. The mineral resources are shown on Plate 1.

Gypsum and clay resources occur in the Verde Valley, but most are controlled by Superior Materials. Gypsum occurs on Forest Service land but drilling is needed to determine the extent of deposits. Clay resources are present at Rogers Lake; it is estimated that about 18,000,000 mt [20 million tons] of high bloating clay exists and may be useful in making lightweight aggregate.

Manganese occurrences in the Long Valley area are relatively widespread but not in quantities large enough to be considered a resource. Occurrences are sporadic and mostly limited to weathered-out nodules. Manganese occurred in place at one locality (sample 200).

The primary resources in the National Forest are cinders and dimension stone. About 4.5 billion cubic meters of volcanic cinders are estimated to be in the Coconino National Forest. The cinder cones, which are found in a wide range of colors, sizes, and degree of sorting, are widely used in construction, cinder block manufacturing, and decorative stone. Dimension stone such as

sandstone is used as building stone, flagstone, decorative stone, and facing stone.

Basalt resources are very extensive; the sampled lavas were sufficiently resistant to abrasion for use in road construction. The primary factor in future development of these resources would be the permitting procedures of the Forest Service.

Pumice is currently being mined north of Flagstaff; additional resources most likely exist near the northern forest boundary. Resources along the north boundary could not be calculated because of limited exposures. Drilling and /or trenching would be needed to accurately delineate resources.

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Table 7.-- Description of samples from the Coconino National Forest, Arizona.

[cps, counts per second; bg, background]

Sample			Location	Description
No.	Type	length (cm.)		
1	Chip	61	T.25N., R.5E., SE sec. 20.	Cinders, charcoal color, welded, 0.6 cm. to 2.5 cm., well-consolidated.
2	Chip	76	T.25N., R.10E., SE sec. 20.	Cinder and ash(?), limonite color, obsidian fragments up to 1.3 cm. diameter, sample contains some pumice, grains between 0.6 cm. and 10.1 cm., stratified.
3	Chip	147	T.24N., R.6E., NW sec. 6.	Cinder pit, medium sorting, dark maroon color, grains 0.6 cm. to 13.0 cm., most less than 2.5 cm., welded material.
4	Grab	Random	T.23N., R.5E., SE sec. 36.	Cinders, charcoal color, dense and basaltic in nature, somewhat rounded, volcanic bombs, abundant dense basalt.
5	Grab	Random	T.23N., R.6E., NW sec. 17.	Cinders, splatter cone (?), welded and unconsolidated material, "taffy-like" texture, small fragments 0.6 cm. to 15.0 cm., maroon to gray color, poorly sorted, not very vesicular.
6	Chip	41	T.25N., R.6E., NE sec. 21.	Shinarump (?), well-rounded quartz pebble conglomerate, up to 3.8 cm. in diameter, coarse-grained sandstone matrix, poorly sorted, may be old stream channel, abundant petrified wood, 90 cps (bg 40 cps).
7	Chip	71	T.25N., R.6E., NE sec. 21.	Shinarump (?) or stream channel in Chinle Fm., rounded pebble conglomerate, poorly-sorted sandstone matrix, gypsum seam near sample area, sulfide smell.
8	Chip	53	T.25N., R.6E., NE sec. 21.	Chinle Fm., carbonaceous trash in old stream channel, pebbles 1.9 cm. to 5.0 cm., petrified wood, 0.6 cm. gypsum seams, limonite staining, 100 cps (bg 75 cps).
9	Chip	66	T.25N., R.6E., NW sec. 26.	Chinle Fm., sandstone, moderately sorted, siltstone, limonite staining, sample 85 cps (bg 20 cps), rounded quartzite pebbles in float (Shinarump?).

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

Sample			Location	Description
No.	Type	length (cm.)		
10	Grab	Random	T.25N., R.6E., NE sec. 26.	Cinders, dark gray to maroon color, poorly sorted, dense, some grains dense and basaltic in nature, minor amount welded material.
11	Grab	Random	T.25N., R.7E., SW sec. 32.	Cinder cone, rust, maroon and black in color, 50% black cinders, medium sorting (5% or less greater than 5 cm.).
12	Do.	Do.	T.24N., R.7E., NW sec. 10.	Cinder cone, red and black cinders, mostly 5.0 cm. or smaller grains, medium sorting.
13	Chip	91	T.24N., R.6E., NE sec. 24.	Cinder cone, 1.3 cm. maximum grain size, well-sorted, black to charcoal color.
14	Grab	Random	T.24N., R.6E., NE sec. 26.	Cinders, well-sorted, largest grains are 1.9 cm., charcoal color, top of cone is red cinders, minor welded material, poorly sorted.
15	Do.	Do.	T.24N., R.7E., NW sec. 28.	Cinders, poorly sorted, 0.6 cm. to 2.54 cm. grain size, some bombs, rust color, some flow and welded material.
16	Chip	122	T.23N., R.7E., NE sec. 5.	Cinder cone, grains 0.6 cm. to 2.5 cm., brownish rust color, abundant welded material, poorly sorted, small bombs.
17	Chip	Random	T.23N., R.6E., SE sec. 12.	Redwall Limestone, gray, fine-grained, caps White Horse Hill.
18	Chip	Random	T.23N., R.6E., SE sec. 12.	Redwall Limestone (?), altered to sugary texture, calcareous.
19	Chip	76	T.23N., R.6E., SE sec. 12.	Quartz latite porphyry, limonite staining, gray on fresh fracture, contains phenocrysts of hornblende (?).
20	Chip	76	T.23N., R.6E., SE sec. 12.	Do.
21	Grab	Random	T.25N., R.7E., NE sec. 23.	Cinders, medium sorting, 85% grains are between 1.9 cm. and 5.0 cm., rust to maroon color, minor welded material, abundant material with "taffy-like" texture.

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

Sample			Location	Description
No.	Type	length (cm.)		
22	Grab	Random	T.25N., R.7E., NE sec. 26.	Cinders, medium sorted, 1.3 cm. to 7.6 cm. grains, minor welded material.
23	Chip	112	T.17N., R.8E., NW sec. 29.	Cinder cone, poorly sorted, red, unconsolidated, grains are up to 10.1 cm., some flow material in cone.
24	Grab	Random	T.25N., R.8E., NE sec. 32.	Pumice, random grab of float material, no exposures of pumice, grains 0.6 cm. to 7.6 cm.
25	Chip	157	T.25N., R.8E., NW sec. 33.	Pumice, very unconsolidated, total thickness not known, fragments up to 7.6 cm., "salt and pepper" effect because of small basalt fragments, overlain by volcanic ash, fragments size increase downward.
26	Chip	137	T.25N., R.8E., SE sec. 28.	Pumice outcrop, most grains 1.3 cm. or smaller,contains some basalt or scoria fragments, welded near top of sample then unconsolidated, reportedly used for Glen Canyon Dam, many old trenches and pits, pumice exposures are rare.
27	Grab	Random	T.24N., R.8E., NE sec. 19.	Cinder cone, brown to rust color, poorly sorted, abundant agglutinate material, some small bombs, grains up to boulder size.
28	Chip	46	T.24N., R.7E., NE sec. 26.	Cinders, poorly sorted, maroon color, abundant welded material.
29	Chip	122	T.23N., R.8E., NW sec. 4.	Andesite breccia, unconsolidated fragments 0.6 cm. to 10.1 cm., gray to purple color, no rounded fragments.
30	Chip	127	T.23N., R.8E., NW sec. 4.	Andesite breccia, unconsolidated fragments 0.6 cm. to 10.1 cm., gray to purple color, no rounded fragments.
31	Chip	127	T.23N., R.8E., SW sec. 9.	Cinder cone, rust-colored, poorly-sorted grains up to 7.6 cm. to 10.1 cm., unconsolidated and agglutinate material on surface.
32	Chip	185	T.23N., R8E., NE sec. 18.	Cinders, black, medium sorting, unconsolidated, 0.3 cm. to 5.0 cm. in size.

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

Sample			Location	Description
No.	Type	length (cm.)		
33	Chip	132	T.23N., R8E., NE sec. 18.	Do.
34	Chip	122	T.25N., R.9E., NW sec. 33.	Cinder cone, maroon to rust color, grains up to 5.0 cm., well-sorted in sample area, sparse fragments of Kaibab Limestone, minor agglutinate material.
35	Grab	Random	T.25N., R.9E., SW sec. 23.	Cinders, maroon and black color, poorly sorted, abundant welded material up to boulder size.
36	Grab	Random	T.23N., R.9E., NE sec. 5.	Cinder cone, 1.9 cm. or smaller grains, homogeneous and well-sorted, olive-black color.
37	Grab	Random	T.23N., R.9E., SW sec. 23.	Cinder cone, well-sorted 0.6 cm. grains, gray color, no welded or agglutinate material.
38	Grab	Random	T.22N., R.9E., NE sec. 5.	Cinders, charcoal color, grains up to 2.5 cm., sell-sorted, homogeneous material.
39	Grab	Random	T.22N., R.9E., SE sec. 9.	Cinder cone, well-sorted 0.6 cm. grains, gray color, no welded or agglutinate material.
40	Chip	91	T.22N., R.10E., SW sec. 19.	Cinders, well-sorted, rust-colored, largest grains are about 1.9 cm., no flow or welded material, most of cone is gray at surface and red toward center.
41	Chip	91	T.22N., R.9E., NW sec. 29.	Cinders, black and well-sorted, grain size 2.5 cm. or less, no flow or agglutinate material.
42	Grab	Random	T.22N., R.10E., SW sec. 8.	Cinder cone, grains mostly <2.5 cm. but some as big as 15.0 cm., maroon color near top of cone, darker toward bottom, mixed with black cinders.
43	Grab	Random	T.22N., R.10E., SE sec 20.	Cinder cone, well-sorted, rust and black cinders, mostly 2.5 cm. or less.
44	Grab	Random	T.22N., R.10E., NW sec. 29.	Volcanic/cinders, poorly sorted, up to 20.0 cm. fragments, maroon color, some minor caliche, some welded material.

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

Sample			Location	Description
No.	Type	length (cm.)		
45	Grab	Random	T.22N., R.10E., NW sec. 29.	Cinders, fine-grained, mostly 0.6 cm., dark gray color, abundant caliche.
46	Grab	Random	T.21N., R.10E., NE sec.9.	Cinder cone, rust color, grains up to 5.0 cm., no good cinder exposure, float is well-sorted and cone is capped with tuff(?).
47	Chip	91	T.20N., R.10E., NW sec. 2.	Cinders, maroon color, medium sorted, 0.6 cm. to 5.0 cm., very unconsolidated, agglutinate material at top of cone.
48	Grab	Random	T.23N., R.6E., SE sec. 27.	Cinders (?), dense and not very vesicular, rounded, brown color, poorly sorted, boulders up to 0.61 m.
49	Grab	Random	T.23N., R.6E., NW sec. 19.	Cinder cone, poorly sorted, 0.6 cm. to 7.6 cm., rust color, dense, not very vesicular, more basalt in nature.
50	Grab	Random	T.21N., R.6E., SW sec. 31.	Clay from Rogers Lake from a 30.5 cm.-deep hole, dark chocolate brown color, minor organic material.
51	Chip	122	T.21N., R.6E., NE sec. 35.	Sinclair Cinder Pit, well-sorted, charcoal to black color, no welded material, 0.6 cm. to 2.5 cm.
52	Chip	104	T.21N., R.6E., NE sec. 35.	Do.
53	Chip	135	T.21N., R.6E., NE sec. 35.	Do.
54	Chip	91	T.21N., R.6E., NE sec. 36.	Dry Lake Cinder Pit, well-sorted, 2.5 cm. or less, no welded material, rust to maroon color.
55	Chip	102	T.21N., R.9E., SE sec. 14.	Cinder cone, well-sorted, maroon color, fine-grained, 1.3 cm. to 3.8 cm.
56	Chip	Random	T.21N., R.9E., SE sec. 23.	Kaibab Limestone, fine- to medium-grained, buff color, minor calcite in vugs, minor chert.
57	Chip	30	T.20N., R.9E., SW sec. 36.	Kaibab Limestone, pit was for onyx which is scarce and found on large boulders as coating, may be some chalcedony.

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

Sample			Location	Description
No.	Type	length (cm.)		
58	Chip	91	T.19N., R.9E., SW sec. 10.	Kaibab Limestone, stockpiles or crushed material about 0.6 cm. to 1.3 cm., probably used for road maintenance.
59	Chip	110kg.	T.19N., R.7E., NW sec. 8.	Lava flow.
60	Chip	Random	T.19N., R.5E., NW sec. 15.	Coconino Sandstone, buff color, fine-grained, orthoquartzite.
61	Chip	Random	T.18N., R.6E., SW sec. 1.	Kaibab Limestone, some vugs, buff color, sandy and probably contains some clay.
62	Chip	110kg.	T.17N., R.6E., NW sec. 2.	Basalt flow.
63	Chip	Random	T.18N., R.4E., SW sec. 17.	Supai Fm., red color, cross-bedded, orthoquartzite.
64	Chip	Random	T.18N., R.4E., SW sec. 17.	Coconino Sandstone or maybe upper Supai Fm., large cross-bedding, buff and red color, orthoquartzite, minor iron-stain banding.
65	Chip	Random	T.18N., R.4E., SW sec. 17.	Coconino Sandstone, orthoquartzite, cross-bedded, buff color, fine-grained, minor iron-stain banding.
66	Chip	Random	T.18N., R.4E., SW sec. 17.	Upper Supai Fm. or lower Coconino Sandstone, cross-bedded, orthoquartzite, red color, fine-grained, minor iron-stain banding.
67	Chip	Random	T.18N., R.4E., SW sec. 18.	Coconino Sandstone, near Coconino-Supai contact, fine-grained, cross-bedded orthoquartzite, reddish tan color, "flagstone".
68	Chip	Random	T.18N., R.4E., NW sec. 19.	Supai Fm., light red to brown color, fine-grained, cross-bedded orthoquartzite, "flagstone".
69	Chip	Random	T.18N., R.3E., SW sec. 25.	Upper Supai Fm., distinctive red sandstone, fine-grained, well-sorted, harder than overlying Coconino Sandstone.
70	Chip	Random	T.18N., R.3E., SE sec. 26.	Coconino Sandstone, tan color, cross-bedded, fine-grained orthoquartzite.
71	Chip	Random	T.18N., R.3E., SW sec. 25.	Do.

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

Sample			Location	Description
No.	Type	length (cm.)		
72	Chip	Random	T.18N., R.3E., SW sec. 25.	Do.
73	Chip	Random	T.18N., R.3E., SW sec. 25.	Coconino Sandstone, light gray to light tan color, fine-grained orthoquartzite, cross-bedded, minor iron-stained banding.
74	Chip	Random	T.18N., R.3E., NW sec. 36.	Basal Coconino Sandstone, gray and maroon colors, orthoquartzite, abundant iron-stained quartz grains that are deep translucent red color.
75	Chip	Random	T.18N., R.3E., SE sec. 35.	Coconino Sandstone, buff color, fine-grained, orthoquartzite, near Coconino-Supai contact, cross-bedded.
76	Chip	Random	T.18N., R.3E., SW sec. 36.	Coconino Sandstone, buff color, fine-grained, orthoquartzite, near Coconino-Supai contact, cross-bedded.
77	Chip	Random	T.17N., R.3E., NE sec. 2.	Coconino or Toroweap Sandstone, cross-bedded and well-sorted, bedding plane 2.5 cm. to 30.5 cm. thick, buff color, limonite banding, "flagstone".
78	Chip	Random	T.17N., R.3E., NE sec. 33.	Redwall Limestone in Sycamore Canyon, fine-grained, gray color.
79	Chip	Random	T.17N., R.3E., SE sec. 33.	Martin Limestone in Sycamore Canyon, fine-grained, gray color, dolomite.
80	Chip	Random	T.17N., R.3E., NW sec. 8.	Martin Limestone in Sycamore Canyon, dolomite, gray color, fine-grained.
81	Chip	Random	T.17N., R.3E., SW sec. 33.	Redwall Limestone at mouth of Sycamore Canyon, crystalline, medium-grained.
82	Chip	61	T.17N., R.3E., NW sec. 24.	Verde Fm., clay and mudstone, light color, 12 cps (bg 12 cps).
83	Chip	64	T.17N., R.3E., NW sec. 24.	Verde Fm., interbedded clay-rich limestone and thin clay seams, 10 cps (bg 8 cps).
84	Chip	76	T.17N., R.3E., NW sec. 24.	Verde Fm., clay and mudstone interbedded with clay-rich limestone, weathered, light tan color, sandy, 22 cps (bg 17 cps).

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

Sample			Location	Description
No.	Type	length (cm.)		
85	Chip	91	T.17N., R.3E., SW sec. 24.	Verde Fm., limestone and minor clay, 21 cps (bg 10 cps).
86	Chip	61	T.17N., R.3E., SW sec. 24.	Verde Fm., clay-rich limestone interbedded with harder, more crystalline limestone, 11 cps (bg 10 cps).
87	Chip	Random	T.17N., R.3E., SW sec. 24.	Verde Fm., hard, mottled limestone, same locality as sample 86, whole rock analysis.
88	Chip	46	T.17N., R.3E., SW sec. 24.	Verde Fm., highly weathered clay and limestone, highly fractured, small vugs in limestone, minor limonite, 25 cps (bg 12 cps).
89	Chip	51	T.17N., R.3E., SW sec. 24.	Verde Fm., massive limestone bed about 102 cm. thick, very hard, brown-gray color, 8 cps (bg 8 cps).
90	Chip	61	T.17N., R.3E., SW sec. 24.	Verde Fm., alternating beds of sandy limestone and hard, chocolate-colored, fine-grained limestone, 8 cps (bg 8 cps).
91	Chip	66	T.17N., R.3E., SW sec. 24.	Verde Fm., interbedded limestone and sandy limestone, each bed 7.6 cm. to 10.2 cm. thick, limestone is fine-grained and light chocolate brown color, 8 cps (bg 8 cps).
92	Chip	107	T.17N., R.3E., SW sec. 24.	Verde Fm., mostly mudstone and clay capped with 20.0 cm. thick limestone bed, light gray color, weathered, 15 cps (bg 15 cps).
93	Chip	91	T.17N., R.3E., SE sec. 23.	Verde Fm., highly weathered calcareous sandstone, abundant mudstone or clay, brown-pink color, slope-forming unit, 28 cps (bg 18 cps).
94	Chip	94	T.17N., R.3E., SW sec. 24.	Verde Fm., limestone, light tan to white color, high clay content, highly weathered and fractured, 28 cps (bg 14 cps).
95	Chip	112	T.17N., R.3E., SE sec. 23.	Verde Fm., highly weathered siltstone and mudstone, light brown color, 26 cps (bg 18 cps).
96	Chip	76	T.17N., R.3E., NE sec. 26.	Verde Fm., weathered sandstone, fine-grained, well-sorted, 26 cps (bg 18 cps).

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

Sample			Location	Description
No.	Type	length (cm.)		
97	Chip	91	T.17N., R.3E., NE sec. 26.	Verde Fm., limestone, mottled, buff color, calcareous sandstone unit under limestone, 20 cps (bg 18 cps).
98	Chip	86	T.17N., R.3E., SE sec. 26.	Verde Fm., calcareous sandstone and siltstone, ledge forming, thinly bedded (less than 30.5 cm.), 38 cps (bg 18 cps).
99	Chip	38	T.17N., R.3E., SE sec. 26.	Verde Formation, light-colored sandy limestone, limonite in vugs and fractures.
100	Chip	51	T.17N., R.3E., SE sec. 26.	Verde Fm., hard limestone, chocolate color, crystals of brown calcite, clay lenses, ledges up to 0.6 m. thick.
101	Chip	91	T.17N., R.3E., SE sec. 26.	Verde Fm., buff-colored limestone, sandy, interbedded with siltstone, minor limonite.
102	Chip	46	T.17N., R.3E., SE sec. 26.	Verde Fm., sandy siltstone and limestone, buff to pink color, fine-grained.
103	Chip	91	T.16N., R.3E., SW sec. 14.	Verde Fm., siltstone interbedded with buff-colored sandy limestone, 70 cps (bg 50 cps).
103	Chip	76	T.17N., R.3E., NE sec. 35.	Verde Fm., red sandstone, weathered, background and sample 20 cps.
104	Chip	64	T.17N., R.3E., NE sec. 35.	Verde Fm., sandy limestone or calcareous sandstone, minor limonite, vuggy, ledge forming.
105	Chip	61	T.17N., R.3E., NE sec. 35.	Verde Fm., calcareous siltstone, tan color, 35 cps (bg 30 cps).
106	Chip	61	T.17N., R.3E., NE sec. 35.	Verde Fm., weathered pink sandstone, 28 cps (bg 15 cps).
107	Chip	99	T.17N., R.3E., NE sec. 35.	Verde Fm., light brown to pink sandstone, 65 cps (bg 32 cps).
108	Chip	94	T.17N., R.3E., NE sec. 35.	Verde Fm., very weathered red sandstone, 40 cps (bg is 20 cps).

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

Sample			Location	Description
No.	Type	length (cm.)		
109	Chip	114	T.17N., R.3E., NE sec. 35.	Verde Fm., interbedded siltstone and limestone, siltstone is 25.0 cm. to 46.0 cm. thick and limestone is 12.7 cm. to 30.5 cm. thick.
110	Chip	56	T.17N., R.3E., NE sec. 35.	Verde Fm., buff-colored siltstone and limestone, carnotite coating fractures and vugs, 95 cps (bg 25 cps), carnotite mostly at sample area, sparse elsewhere.
111	Grab	na	T.17N., R.3E., NE sec. 35.	Verde Fm., high-grade sample of carnotite.
112	Chip	Random	T.17N., R.3E., SE sec. 35.	Verde Fm., fine-grained limestone, 95 cps (bg 25 cps).
113	Chip	122	T.17N., R.3E., SE sec. 35.	Verde Fm., calcareous sandstone or sandy limestone, light gray color.
114	Chip	38	T.17N., R.3E., SE sec. 35.	Verde Fm., chocolate-colored, siltstone, sandstone ledge over siltstone, 50 cps (bg 30 cps),sandstone above had only 20 cps.
115	Chip	76	T.17N., R.3E., NW sec. 35.	Verde Fm., alternating limestone and siltstone, limestone is fractured and sandy, siltstone red color and weathered, 20 cps (bg 20 cps).
116	Chip	117	T.16N., R.3E., NW sec. 11.	Verde Fm., beds of limestone, shaley mudstone containing minor carnotite, silty clay-rich limestone and silty mudstone, 200 cps (bg 50 cps).
117	Chip	91	T.16N., R.3E., SW sec. 11.	Verde Fm., weathered mudstone overlying 20.0 cm. limestone bed, brown color, limestone is gray color, small vugs, 60 cps (bg 40 cps).
118	Chip	61	T.16N., R.3E., SE sec. 10.	Verde Fm., calcareous mudstone and siltstone overlying hard limestone bed, weathered and fractured, minor limonite on some fractures and in small vugs in limestone, carnotite, 200 cps (bg 80 cps).
119	Chip	61	T.16N., R.3E., SE sec. 10.	Verde Fm., limestone, silty limestone and siltstone, alternating beds, 60 cps (bg 40 cps).

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

Sample			Location	Description
No.	Type	length (cm.)		
120	Chip	Random	T.16N., R.3E., NE sec. 15.	Verde Fm., very old trench covered with vegetation and alluvium, mostly gray limestone, hard , slightly silty, no bed rock exposure, 42 cps (bg 30 cps).
121	Chip	66	T.16N., R.3E., NW sec. 14.	Verde Fm., calcareous mudstone, brown to gray color, highly weathered, thin bedded 5.0 cm. or less, 40 cps (bg 30 cps).
122	Chip	61	T.16N., R.3E., NW sec. 14.	Verde Fm., calcareous mudstone and sandstone beds alternating with thin limestone beds, gray to brown color, 40 cps (bg 35 cps).
123	Chip	Random	T.16N., R.3E., NW sec. 14.	Verde Fm., limestone, fine-grained, brown in color, small vugs, abundant alluvium, old trench where bedrock has been scraped into dump, 42 cps (bg 30 cps).
124	Grab	Random	T.16N., R.3E., NW sec. 14.	Verde Fm., white to buff-colored siltstone, mudstone, sample of dump material, 75 cps (bg 45 cps), no bedrock outcrop.
125	Chip	61	T.16N., R.3E., NW sec. 14.	Verde Fm., nodular, calcareous, sandy unit mixed with siltstone and overlain by limestone.
126	Grab	Random	T.16N., R.3E., NW sec. 14.	Verde Fm., mostly alluvium, fragments of sandy and clay-rich limestone.
127	Chip	117	T.16N., R.3E., NE sec. 15.	Verde Fm., interbedded mudstone and limestone, abundant carnotite near top of sample and in float, 200 cps (bg 100 cps).
128	Chip	51	T.16N., R.3E., SE sec. 15.	Verde Fm., sandy limestone, gray to gray-brown color, fine-grained, 200 cps (bg 100 cps).
129	Chip	102	T.16N., R.3E., SE sec. 15.	Verde Fm., mostly mudstone with thin bed of limestone, light gray color, weathered, 70 cps (bg 40 cps).
131	Chip	76	T.16N., R.3E., SW sec. 14.	Verde Fm., highly fractured, clay-rich limestone, 90 cps (bg 80 cps).
132	Chip	58	T.16N., R.3E., SW sec. 14.	Verde Fm., mudstone and clay interbedded with clay-rich limestone, 70 cps (bg 60 cps).

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

Sample			Location	Description
No.	Type	length (cm.)		
133	Chip	61	T.16N., R.3E., SW sec 14.	Verde Fm., buff color, calcareous siltstone, 130 cps (bg 40 cps).
134	Chip	30	T.16N., R.3E., SW sec. 14.	Verde Fm., limestone overlying clay seam, vuggy and massive, clay is very light gray color, 140 cps (bg 70 cps).
135	Chip	56	T.16N., R.3E., NW sec. 23.	Verde Fm., sandy limestone unit, resistant to weathering, fractured, 200 cps (bg 60 cps).
136	Chip	Random	T.16N., R.3E., NW sec. 23.	Verde Fm., limestone, mottled, hard, gray color, 150 cps (bg 75 cps).
137	Chip	61	T.16N., R.3E., SE sec 22.	Verde Fm., siltstone, mudstone, and limestone, tan to gray-color, 190 cps (bg 40 cps).
138	Chip	91	T.16N., R.3E., SE sec 22.	Verde Fm., buff to light-gray color, sandstone and limestone, 100 cps (bg 45 cps).
139	Chip	61	T.16N., R.3E., SE sec. 14.	Verde Fm., sandstone, calcareous, massive ledge and resistant to weathering, 40 cps (bg 40 cps).
140	Chip	84	T.16N., R.3E., SE sec. 14.	Verde Fm., gray limestone grading into pinkish sandstone, 40 cps (bg 30 cps).
141	Chip	61	T.16N., R.3E., SE sec. 14.	Verde Fm., thin-bedded clay rich limestone, 50 cps (bg 50 cps).
142	Chip	71	T.16N., R.3E., SE sec. 14.	Verde Fm., mudstone, white to light gray color, weathered, 100 cps (bg 20 cps).
143	Chip	61	T.16N., R.3E., SE sec. 14.	Verde Fm., white clay and mudstone beneath sandy limestone unit, carnotite, 89 cps (bg 34 cps).
144	Chip	69	T.16N., R.3E., SE sec. 14.	Verde Fm., buff to light gray, calcareous clay and clay-rich limestone, thin-bedded, 40 cps (bg 40 cps).
145	Chip	89	T.16N., R.3E., NE sec. 14.	Verde Fm., interbedded mudstone and limestone, abundant carnotite and clay, 120 cps (bg 50 cps).
146	Chip	71	T.16N., R.3E., NE sec. 14.	Verde Fm., limestone, contains thin-bedded mudstone and clay, 24 cps (bg 22 cps).

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

Sample			Location	Description
No.	Type	length (cm.)		
147	Grab	Random	T.16N., R.3E., NE sec. 14.	Verde Fm., trench mostly in alluvium, no good rock outcrops, mostly thin-bedded and sandy limestone, buff to tan color, minor carnotite (?).
148	Chip	76	T.16N., R.3E., NE sec. 14.	Verde Fm., limestone, massive and hard, vugs up to 5.0 cm. diameter, thin-bedded clay seam, lower part of sample is mudstone, 32 cps (bg 25 cps).
149	Chip	76	T.16N., R.3E., NE sec. 14.	Verde Fm., limestone, clay-rich, hard, light tan color, 120 cps (bg 40 cps).
150	Chip	79	T.16N., R.3E., NE sec. 14.	Verde Fm., limestone, fine-grained, grayish brown color, overlies weathered mudstone, 42 cps (bg 40 cps).
151	Chip	61	T.16N., R.3E., NE sec. 14.	Verde Fm., decomposed sandstone, lens of limonite-stained sandstone, 25 cps (bg 20 cps).
152	Chip	76	T.16N., R.3E., SE sec. 11.	Verde Fm., silty mudstone bed, 40 cps (bg 30 cps).
153	Chip	109	T.16N., R.3E., SE sec. 11.	Verde Fm., alternating, mudstone, sandstone, and siltstone beds, 26 cps (bg 20 cps).
154	Chip	86	T.16N., R.3E., SE sec. 11.	Verde Fm., interbedded limestone and mudstone, carnotite zone in sandy limestone, 160 cps (bg 70 cps).
155	Chip	130	T.16N., R.3E., SE sec. 11.	Verde Fm., alternating beds of limestone, mudstone, and sandstone, 22 cps (bg 20 cps).
156	Chip	76	T.16N., R.3E., SE sec. 11.	Verde Fm., limestone and mudstone, limestone is fine-grained, gray color and hard, mudstone is weathered, brown color, 42 cps (bg 25 cps).
157	Chip	Random	T.16N., R.3E., SE sec. 11.	Verde Fm., altered limestone, abundant limonite, orange to rust color, limestone is layered and some may be marble, exposed material is mudstone and sandy limestone, MnO on some fractures in altered limestone, 48 cps (bg 26 cps).

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

Sample			Location	Description
No.	Type	length (cm.)		
158	Chip	86	T.16N., R.3E., NE sec. 11.	Verde Fm., limestone overlying sandstone and siltstone, limestone fractured and weathered, 30 cps (bg 26 cps).
159	Chip	46	T.16N., R.3E., SW sec. 12.	Verde Fm., hard siliceous limestone, white color, limonite specks, aphanitic, 70 cps (bg 35 cps).
160	Chip	36	T.16N., R.3E., SW sec. 12.	Verde Fm., uranium-rich limestone and shale, 300 cps (bg 30 cps), decreases laterally and vertically, shale gray color, limestone is hard and white.
161	Chip	89	T.16N., R.3E., SW sec. 12.	Verde Fm., sandy limestone, white to buff color, yellowish-green staining "zones" or "pods", 60 cps (bg 30 cps).
162	Chip	97	T.16N., R.3E., SE sec. 12.	Verde Fm., white limestone, chalky appearance, clay, 30 cps (bg 25 cps).
163	Chip	91	T.16N., R.3E., SE sec. 12.	Verde Fm., sandy limestone, white to gray-brown color, 30 cps (bg 20 cps).
164	Chip	51	T.16N., R.3E., SE sec. 12.	Verde Fm., very sandy limestone, reddish-tan color, 28 cps (bg 20 cps).
165	Chip	109	T.16N., R.3E., SE sec. 12.	Verde Fm., fine-grained,massive limestone over fractured sandstone, siltstone and mudstone under sandstone, 30 cps (bg 22 cps).
166	Chip	79	T.16N., R.3E., NE sec> 12.	Verde Fm., sandy limestone, forms ledge about 9.1 m. thick, clay unit about 5.0 cm. thick, 25 cps (bg 22 cps).
167	Chip	76	T.16N., R.3E., NE sec. 12.	Verde Fm., limestone, white color, fractured, weathered, abundant sand and clay in limestone, 30 cps (bg 25 cps)
168	Chip	61	T.16N., R.3E., NE sec. 12.	Verde Fm., highly weathered, calcareous sandstone near top of formation, 22 cps (bg 18 cps).
169	Chip	122	T.17N., R.3E., SE sec. 31.	Verde Fm., hard, gray limestone overlying fractured sandstone and siltstone, buff to brown color, 22 cps (bg 18 cps).

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

Sample			Location	Description
No.	Type	length (cm.)		
170	Chip	53	T.17N., R.4E., SE sec. 31.	Verde Fm., calcareous siltstone interbedded with small shale units about 1.3 cm. thick, 28 cps (bg 20 cps).
171	Chip	76	T.17N., R.4E., SE sec. 31.	Verde Fm., limestone, sandy and gray color, white clay or mudstone under limestone, 22 cps (bg 15 cps).
172	Chip	76	T.17N., R.4E., SE sec. 31.	Verde Fm., calcareous siltstone and sandstone, buff color, weathered, 15 cps (bg 15 cps).
173	Chip	91	T.17N., R.4E., SW sec. 31.	Verde Fm., calcareous sandstone and siltstone, buff to white color, 20 cps (bg 20 cps).
174	Chip	99	T.17N., R.3E., SE sec. 36.	Verde Fm., calcareous sandstone and siltstone interbedded with shaley units 5.0 cm. to 7.6 cm. thick, buff to white color.
175	Chip	107	T.17N., R.3E., NE sec. 36.	Verde Fm., clay and mudstone capper with limestone, white to buff color.
176	Chip	102	T.17N., R.4E., SW sec. 30.	Verde Fm., 20.3 cm. limestone unit overlying calcareous sandstone and mudstone or clay, 18 cps (bg 15 cps).
177	Chip	119	T.17N., R.4E., SE sec. 19.	Verde Fm., weathered sandstone, rust color, minor mudstone, 26 cps (bg 15 cps).
178	Chip	91	T.17N., R.4E., SE sec. 19.	Verde Fm., red sandstone, fractured and weathered, some siltstone, 22 cps (bg 15 cps).
179	Chip	76	T.17N., R.5E., SE sec. 19.	Supai Fm., hard, dark rust color, well-sorted, minor bleached banding.
180	Chip	43	T.15N., R.6E., SE sec. 30.	Verde Fm., limestone, 43.2-cm.-thick bed of travertine, banded, cream to tan color, very hard, small vugs up to 3.8 cm. diameter, crystalline.
181	Chip	61	T.15N., R.6E., NW sec. 31.	Verde Fm., limestone, crystalline, vuggy, tan color, bedding up to 1.2 m. thick, has been drilled and quarried.
182	Chip	61	T.14N., R.5E., NE sec. 29.	Verde Fm., clay, olive green color, fine-grained, very sticky when wet.

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

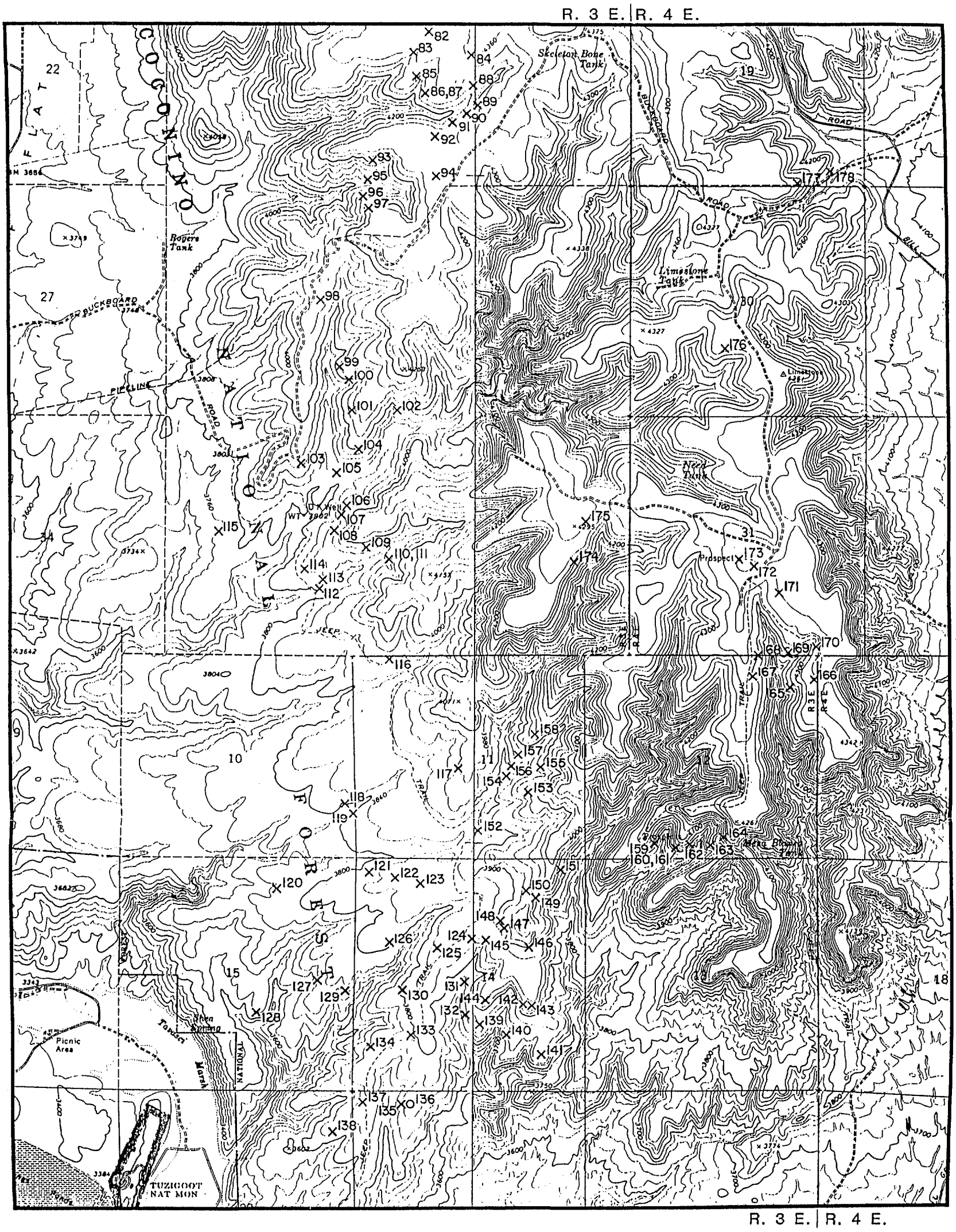
Sample			Location	Description
No.	Type	length (cm.)		
183	Chip	Random	T.14N., R.5E., NW sec. 28.	Verde Fm., limestone, buff color, vuggy, somewhat siliceous.
184	Grab	Random	T.13N., R.5E., NE sec. 10.	Verde Fm., clay taken from 25.4-cm. deep hole, gray to light green color, fine-grained.
185	Chip	30	T.13N., R.5E., SW sec. 10.	Clay, light green to gray color, gypsum mixed with clay, very small exposure.
186	Chip	76	T.13N., R.5E., NE sec. 22.	Verde Fm., clay, light gray to gray color, minor gypsum.
187	Chip	46	T.13N., R.5E., NE sec. 22.	Gypsum bed between clay beds, brown color.
188	Chip	Random	T.13N., R.6E., SE sec. 6.	Verde Fm., limestone, white to buff color, sandy, slickensides, 5.0 cm. chert beds, no bedrock exposures.
189	Chip	61	T.13N., R.6E., NE sec. 7.	Volcanics, bombs, welded material, no radioactive readings, maroon to rust color, pyroclastics.
190	Grab	Random	T.12N., R.8E., NW sec. 21.	Coconino Sandstone, quarry, light buff color, fine-grained, iron-stain banding, orthoquartzite.
191	Chip	Random	T.12N., R.8E., SE sec. 16.	Coconino Sandstone, quarry, buff to red color, cross-bedded, orthoquartzite, fine-grained, fractured and faulted.
192	Chip	Random	T.12N., R.8E., NE sec. 16.	Andesite (?) or a dacite (?) porphyry, aphanitic, gray color, large pit/quarry.
193	Chip	76	T.14N., R.9E., SE sec. 13.	Mineralized breccia, psilomelane, limonite and hematite, Kaibab Limestone country rock, most likely a solution-filled breccia zone.
194	Grab	Random	T.14N., R.9E., SW sec. 24.	Mineralized float in ore loading area, no indication of source of mineralized rock, psilomelane, swirled and banded mineralization, Kaibab Limestone host rock.
195	Grab	Random	T.14N., R.9E., SW sec. 24.	Rounded manganese nodules in alluvium, pyrite psuedomorphs of hematite and are slightly rounded.

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

Sample			Location	Description
No.	Type	length (cm.)		
196	Grab	Random	T.14N., R.10E., NE sec. 30.	Mn in alluvium, Kaibab Limestone country rock, no Mn in place, Mn pieces usually less than 5.0 cm. in diameter.
197	Do.	Do.	T.14N., R.10E., SW sec. 20.	Do.
198	Do.	Do.	T.14N., R.10E., SW sec. 20.	Basically the same as samples 196 and 197, more Mn present, some nodules contain limonite and iron staining.
199	Chip	Random	T.14N., R.10E., SE sec. 9.	Mineralized breccia-conglomerate in Moenkopi Fm., zone of conglomerate (very few angular fragments) that has manganese matrix , no mineralization in place, all is in float, psilomelane, country rock unknown.
200	Chip	51	T.14N., R.10E., SE sec. 9.	Manganese strata in Moenkopi Fm., thin manganese interlayered with thin siltstone and sandstone beds, manganese botryoidal in places and layered in others, sample adjacent to caved shaft (?).
201	Chip	61	T.14N., R.10E., SE sec. 9.	Moenkopi Fm., red to brown color, thin bedded (7.6 cm. to 10.2 cm.) siltstone.
202	Chip	Random	T.14N., R.10E., NW sec. 24.	Travertine in Kaibab Limestone, calcite, hard and banded, small vugs lined with calcite crystals.
203	Grab	Random	T.13N., R.11E., SW sec. 7.	Botryoidal psilomelane in alluvium, country rock is fine-grained, well-sorted sandstone (Coconino Sandstone ?), trenches and pits that are old, weathered and irregular size.
204	Grab	Random	T.13N., R.11E., SW sec. 7.	Do.
205	Grab	Random	T.14N., R.11E., NE sec. 34.	Psilomelane near Kaibab Limestone-basalt contact, manganese in stockpiles and scattered in float, abundant travertine nearby.
206	Chip	Random	T.14N., R.11E., SW sec. 35.	Coconino Sandstone, fine-grained orthoquartzite, cross-bedded, banded with iron staining.

Table 7.-- Description of samples from the Coconino National Forest, Arizona.--Continued

Sample			Location	Description
No.	Type	length (cm.)		
207	Chip	Random	T.13N., R.11E., SW sec. 2.	Kaibab Limestone, dolomite, very hard, grayish brown color, ledge forming.
208	Grab	Random	T.13N., R.12E., SE sec. 7.	Hematite and manganese oxide in float material, abundant limonite, solution banding, Kaibab Limestone likely is country rock.
209	Chip	122	T.16N., R.9E., SW sec. 29.	Cinders, well-sorted, maroon color, grains less than 1.3 cm.
210	Chip	76	T.16N., R.9E., NW sec. 29.	Cinders, tan to brown color, may be clay in decomposed cinders, very vesicular.



EXPLANATION

136 O LOCALITY OF SAMPLED OUTCROP--Showing sample number

143 X PROSPECT--Showing sample number

-N-

0 500 1,000 1,500 2,000 m

0 2,000 4,000 6,000 8,000 ft

Figure 3.--Location map for samples 82-178, Coconino National Forest, Arizona. (see inset plate 3)

Appendix A- Analytical results for samples from Coconino National Forest, Arizona.

[Analyses by Chemex, Sparks, NV; ICP methods; Al, Ca, Fe, K, Mg, Na, Ti %, all other units ppm; samples 24-26, 50, 59, 62, 182, and 184-187 are clay, lava, and pumice samples and do not appear in this table.]

Sample Number	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La
1	2.2	3.71	20	280	<0.5	<2	2.75	<0.5	40	57	62	7.79	30	<1	0.30	30
2	2.6	5.26	<5	430	<0.5	10	4.58	<0.5	38	51	66	7.08	30	<1	0.27	20
3	<0.2	1.60	<5	70	1.5	4	1.95	0.5	24	22	26	3.77	<10	<1	0.08	10
4	3.0	1.03	<5	110	<0.5	4	1.56	<0.5	20	11	10	8.58	30	<1	0.15	50
5	1.0	1.18	10	20	<0.5	6	1.07	<0.5	25	55	47	3.79	10	<1	0.04	10
6	<0.2	0.29	55	400	0.5	4	0.12	<0.5	1	49	7	0.91	20	<1	0.22	40
7	<0.2	1.04	5	710	<0.5	<2	0.59	<0.5	4	28	5	1.51	20	<1	0.18	50
8	<0.2	0.65	30	260	<0.5	2	0.57	<0.5	2	25	9	2.29	10	<1	0.09	50
9	<0.2	1.24	10	400	0.5	<2	1.01	<0.5	2	13	5	0.76	10	<1	0.13	70
10	<0.2	0.97	<5	130	1.0	6	0.68	<0.5	26	34	35	3.40	<10	<1	0.12	10
11	<0.2	1.17	<5	140	<0.5	4	0.79	<0.5	20	10	4	6.21	<10	<1	0.18	20
12	<0.2	3.41	<5	220	<0.5	<2	2.78	0.5	32	65	58	5.40	<10	1	0.29	10
13	<0.2	4.47	20	700	0.5	<2	3.59	<0.5	41	51	42	6.05	<10	2	0.37	20
14	<0.2	2.66	100	1190	4.5	<2	2.22	<0.5	46	34	41	4.59	<10	<1	0.25	20
15	<0.2	1.84	<5	210	3.5	4	1.93	0.5	25	13	79	4.23	<10	<1	0.15	70
16	<0.2	2.89	<5	240	3.0	6	2.43	<0.5	29	45	28	4.85	<10	1	0.18	20
17	1.0	0.01	10	<10	<0.5	14	>15.00	<1.0	<1	6	1	0.03	100	3	<0.01	50
18	0.2	0.03	5	<10	<0.5	2	>15.00	<1.0	2	7	2	0.02	100	6	<0.01	50
19	<0.2	0.42	5	210	<0.5	22	0.75	<1.0	6	<1	11	3.72	<10	<1	0.13	40
20	<0.2	0.47	<5	260	<0.5	<2	0.76	<1.0	5	2	10	3.91	<10	2	0.18	40
21	<0.2	2.08	<5	210	<0.5	<2	1.70	<0.5	18	73	48	3.07	<10	1	0.20	20
22	<0.2	1.06	20	410	<0.5	<2	1.05	<0.5	26	28	66	3.65	<10	2	0.14	30
23	<0.2	0.68	5	40	<0.5	4	0.93	<0.5	22	53	55	2.11	<10	4	0.02	10
27	<0.2	2.49	<5	280	<0.5	<2	2.05	<0.5	19	38	39	3.69	<10	2	0.25	30
28	<0.2	2.11	150	1170	0.5	<2	1.45	<0.5	43	41	76	2.56	<10	1	0.15	10
29	<0.2	0.25	<5	60	<0.5	<2	0.17	<0.5	<1	3	3	1.67	<10	<1	0.11	30
30	<0.2	0.26	<5	80	<0.5	<2	0.18	<0.5	1	10	6	1.61	<10	<1	0.10	30
31	<0.2	1.44	<5	150	0.5	<2	1.89	<0.5	18	30	74	2.73	<10	<1	0.09	20
32	<0.2	3.42	<5	430	<0.5	<2	3.00	<0.5	26	115	73	4.59	<10	<1	0.25	10
33	<0.2	3.50	<5	420	<0.5	<2	3.19	<0.5	26	136	69	4.55	<10	<1	0.29	<10
34	<0.2	2.33	<5	110	<0.5	<2	2.62	<0.5	20	31	58	2.64	<10	1	0.11	<10

Appendix A- Analytical results from Coconino National Forest, Arizona.--Continued

Sample Number	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La
35	<0.2	2.72	<5	230	<0.5	<2	2.38	<0.5	20	14	42	3.40	<10	1	0.17	40
36	<0.2	4.73	<5	320	<0.5	<2	4.03	0.5	37	91	44	6.43	<10	<1	0.49	<10
37	<0.2	5.11	<5	340	0.5	<2	4.69	1.0	36	101	46	6.73	<10	1	0.54	<10
38	<0.2	3.39	<5	210	<0.5	<2	2.70	<0.5	33	84	41	5.58	<10	3	0.29	10
39	<0.2	2.92	<5	210	<0.5	<2	2.77	0.5	35	71	32	5.46	<10	2	0.28	<10
40	<0.2	1.35	<5	90	<0.5	4	1.12	<0.5	23	30	10	3.26	<10	<1	0.13	<10
41	<0.2	4.44	<5	1010	<0.5	<2	4.53	0.5	30	41	93	5.86	<10	1	0.78	70
42	<0.2	3.16	<5	210	<0.5	<2	2.93	0.5	32	68	32	5.35	<10	<1	0.31	10
43	1.6	3.45	40	220	<0.5	<2	3.29	<0.5	34	61	37	5.99	10	<1	0.31	20
44	0.8	2.18	20	60	<0.5	8	2.99	<0.5	32	13	19	4.99	<10	<1	0.20	10
45	1.4	3.20	15	190	<0.5	8	2.57	<0.5	37	69	36	5.81	10	<1	0.26	20
46	<0.2	2.45	<5	230	<0.5	<2	2.06	<0.5	26	57	31	4.33	<10	2	0.23	20
47	1.0	0.71	<5	70	<0.5	<2	0.86	<0.5	12	37	20	1.42	10	<1	0.03	10
48	<0.2	1.60	<5	110	4.0	14	1.07	0.5	23	9	10	6.79	<10	<1	0.17	20
49	1.2	1.78	5	90	<0.5	4	1.02	<0.5	18	43	25	4.14	10	<1	0.13	20
51	1.2	0.92	<5	150	<0.5	6	1.27	<0.5	16	73	10	6.42	<10	<1	0.16	20
52	2.0	1.52	<5	290	<0.5	<2	1.57	<0.5	19	52	13	7.00	<10	<1	0.22	20
53	1.4	1.34	10	240	<0.5	6	1.30	<0.5	18	53	17	6.23	<10	<1	0.17	20
54	0.6	0.54	20	60	<0.5	4	1.07	<0.5	13	33	9	2.65	10	<1	0.06	20
55	0.6	0.75	<5	60	<0.5	<2	0.79	<0.5	15	42	26	1.12	<10	<1	0.04	<10
56	0.2	0.17	<5	<10	<0.5	<2	>15.00	<1.0	4	19	1	0.39	50	1	0.06	30
57	<0.2	0.11	25	<10	<0.5	<2	>15.00	<0.5	<1	13	4	0.25	<10	<1	<0.01	<10
58	<0.2	0.40	5	10	<0.5	2	14.98	<0.5	2	21	7	0.37	<10	<1	0.11	<10
60	<0.2	0.26	<5	<10	<0.5	<2	0.16	<0.5	4	50	6	0.09	<10	6	0.08	<10
61	<0.2	0.2	<5	<10	<0.5	16	>15.00	2.0	<1	18	2	0.26	50	<1	0.04	40
63	<0.2	0.31	5	20	<0.5	28	0.07	<1.0	<1	22	<1	0.52	10	<1	0.13	<10
64	<0.2	0.25	25	30	<0.5	4	0.63	<1.0	<1	26	1	0.22	10	<1	0.15	<10
65	<0.2	0.23	<5	10	<0.5	4	0.04	<1.0	<1	30	1	0.26	<10	5	0.09	<10
66	<0.2	0.31	10	70	<0.5	4	1.16	1.0	<1	30	3	0.33	10	4	0.14	<10
67	0.8	0.2	<5	10	<0.5	10	0.22	<1.0	<1	37	20	0.24	10	<1	0.04	<10
68	0.2	0.3	5	20	<0.5	<2	0.26	<1.0	<1	25	1	0.38	10	1	0.15	<10
69	<0.2	0.41	10	40	<0.5	14	1.20	<1.0	3	12	<1	0.86	10	<1	0.27	10
70	<0.2	0.39	<5	30	<0.5	4	1.32	<1.0	2	26	3	0.38	10	<1	0.18	<10

Appendix A- Analytical results from Coconino National Forest, Arizona.--Continued

Sample Number	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La
71	<0.2	0.31	<5	10	<0.5	<2	0.03	<1.0	<1	31	1	0.48	<10	2	0.13	<10
72	<0.2	0.31	<5	10	<0.5	4	0.27	<1.0	<1	30	1	0.37	10	<1	0.12	<10
73	0.2	0.30	10	170	<0.5	<2	0.07	<1.0	4	22	7	0.46	<10	<1	0.11	<10
74	<0.2	0.41	5	40	<0.5	12	1.61	<1.0	1	26	4	0.52	10	<1	0.19	10
75	0.2	0.24	<5	10	<0.5	10	0.38	<1.0	<1	23	28	0.16	10	5	0.12	<10
76	<0.2	0.33	10	20	<0.5	<2	0.27	<1.0	<1	22	10	0.25	10	1	0.15	<10
77	<0.2	0.29	<5	20	<0.5	<2	0.78	<0.5	<1	36	5	0.58	<10	1	0.12	<10
78	0.4	0.04	5	<10	<0.5	6	>15.00	<1.0	<1	5	2	0.07	100	4	<0.01	50
79	<0.2	0.23	<5	20	<0.5	16	>15.00	<1.0	1	5	<1	0.61	60	<1	0.12	30
80	0.4	0.32	5	10	<0.5	6	>15.00	<1.0	2	6	5	0.53	60	6	0.17	30
81	<0.2	0.04	<5	20	<0.5	<2	>15.00	1.0	<1	4	2	0.09	100	6	0.01	50
82	<0.2	0.47	<5	230	<0.5	<2	>15.00	0.5	7	20	5	0.38	<10	8	0.08	20
83	<0.2	0.25	10	270	<0.5	<2	>15.00	<0.5	2	20	7	0.21	<10	6	0.03	20
84	<0.2	1.13	<5	310	<0.5	<2	9.66	<0.5	7	33	9	0.87	<10	<1	0.23	20
85	<0.2	0.51	<5	260	<0.5	<2	>15.00	<0.5	4	20	10	0.41	<10	<1	0.10	30
86	<0.2	0.56	35	470	<0.5	<2	>15.00	<0.5	3	23	7	0.52	<10	<1	0.09	20
87	<0.2	0.07	5	280	<0.5	<2	>15.00	<0.5	4	16	8	0.08	<10	2	0.01	20
88	<0.2	1.42	<5	1440	<0.5	<2	>15.00	<0.5	5	26	18	1.03	<10	<1	0.21	30
89	<0.2	0.56	5	90	<0.5	<2	>15.00	<0.5	<1	24	7	0.45	<10	2	0.06	20
90	<0.2	0.17	<5	330	<0.5	<2	>15.00	<0.5	1	18	5	0.15	<10	6	0.01	20
91	<0.2	0.20	15	570	<0.5	<2	>15.00	<0.5	5	13	6	0.18	<10	<1	0.03	20
92	<0.2	1.50	<5	240	<0.5	<2	>15.00	<0.5	7	26	13	1.12	<10	3	0.22	30
93	<0.2	2.38	<5	300	<0.5	<2	4.01	<0.5	8	41	17	1.51	<10	3	0.32	20
94	<0.2	1.86	<5	240	<0.5	<2	11.58	<0.5	12	37	15	1.52	<10	4	0.33	20
95	<0.2	3.81	5	870	<0.5	<2	10.30	<0.5	18	31	21	1.62	<10	<1	0.41	30
96	<0.2	1.37	10	180	<0.5	<2	3.01	<0.5	9	33	12	0.77	<10	<1	0.22	10
97	<0.2	1.25	<5	270	<0.5	14	13.70	<0.5	5	33	11	0.96	<10	<1	0.22	30
98	<0.2	0.64	35	510	<0.5	<2	>15.00	<0.5	2	16	5	0.55	<10	<1	0.13	<10
99	<0.2	0.28	10	190	<0.5	<2	>15.00	<0.5	2	7	3	0.32	<10	<1	0.06	<10
100	<0.2	0.30	<5	240	<0.5	<2	>15.00	<0.5	3	22	2	0.21	<10	<1	0.05	<10
101	<0.2	0.58	50	210	<0.5	<2	>15.00	<0.5	4	23	5	0.70	<10	<1	0.12	<10
102	<0.2	0.92	<5	240	<0.5	<2	>15.00	<0.5	3	26	7	0.64	<10	<1	0.17	<10
103	<0.2	0.54	5	330	<0.5	<2	>15.00	<0.5	4	40	4	0.46	<10	<1	0.11	<10
104	<0.2	0.55	40	130	<0.5	<2	>15.00	<0.5	3	14	6	0.50	<10	<1	0.10	<10
105	<0.2	0.81	10	360	<0.5	<2	>15.00	<0.5	1	27	5	0.55	<10	<1	0.18	<10

Appendix A- Analytical results from Coconino National Forest, Arizona.--Continued

Sample Number	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La
106	<0.2	1.00	5	210	<0.5	<2	8.41	<0.5	3	49	6	0.79	<10	<1	0.20	<10
107	<0.2	0.65	<5	80	<0.5	<2	>15.00	<0.5	2	39	4	0.49	<10	<1	0.13	<10
108	<0.2	1.63	<5	220	<0.5	<2	8.84	<0.5	5	46	11	1.36	<10	<1	0.34	<10
109	<0.2	1.56	<5	2270	<0.5	<2	14.92	<0.5	5	42	10	1.09	<10	<1	0.32	<10
110	<0.2	0.85	<5	150	<0.5	<2	>15.00	<0.5	<1	20	3	0.54	<10	<1	0.17	<10
111	<0.2	0.39	<5	100	<0.5	<2	>15.00	<0.5	<1	10	2	0.27	<10	<1	0.07	<10
112	<0.2	0.12	5	240	<0.5	<2	>15.00	<0.5	<1	13	8	0.23	<10	1	0.05	<10
113	<0.2	0.95	10	480	<0.5	<2	>15.00	<0.5	2	34	6	0.86	<10	1	0.25	<10
114	<0.2	1.77	10	160	<0.5	<2	>15.00	<0.5	4	29	14	1.35	<10	<1	0.43	<10
115	<0.2	0.89	30	180	<0.5	<2	>15.00	<0.5	10	32	12	0.78	<10	<1	0.18	30
116	<0.2	0.73	10	220	<0.5	<2	>15.00	<0.5	6	22	8	0.73	<10	4	0.16	20
117	<0.2	1.29	<5	400	<0.5	4	>15.00	<0.5	8	28	11	1.19	<10	1	0.25	30
118	<0.2	0.60	25	530	<0.5	<2	>15.00	<0.5	5	19	7	0.66	<10	4	0.13	30
119	<0.2	0.96	5	360	<0.5	<2	>15.00	<0.5	7	26	8	0.72	<10	2	0.14	20
120	<0.2	0.66	<5	130	<0.5	<2	>15.00	<0.5	5	23	7	0.51	<10	<1	0.08	30
121	<0.2	1.48	<5	240	<0.5	<2	>15.00	<0.5	10	28	14	1.05	<10	<1	0.24	30
122	<0.2	0.92	5	430	<0.5	<2	>15.00	<0.5	8	23	11	0.65	<10	<1	0.18	20
123	<0.2	0.21	<5	450	<0.5	<2	>15.00	<0.5	5	26	5	0.36	<10	3	0.04	20
124	<0.2	0.83	20	640	<0.5	<2	>15.00	<0.5	<1	17	20	0.62	<10	2	0.23	<10
125	<0.2	0.57	5	270	<0.5	<2	>15.00	<0.5	<1	21	4	0.63	<10	2	0.13	<10
126	<0.2	0.45	15	370	<0.5	<2	>15.00	<0.5	9	22	6	0.58	<10	<1	0.09	20
127	<0.2	0.45	45	460	<0.5	<2	>15.00	<0.5	7	12	10	0.53	<10	<1	0.08	20
128	<0.2	0.27	25	210	<0.5	<2	>15.00	<0.5	1	11	9	0.26	<10	<1	0.05	20
129	<0.2	1.26	30	490	<0.5	<2	>15.00	<0.5	5	36	10	1.11	<10	9	0.22	30
130	<0.2	0.80	5	260	<0.5	<2	>15.00	<0.5	1	26	11	0.70	<10	2	0.18	<10
131	<0.2	0.56	15	590	<0.5	6	>15.00	<0.5	5	17	9	0.48	<10	<1	0.09	30
132	<0.2	0.58	15	5910	<0.5	<2	>15.00	<0.5	5	17	9	0.45	<10	2	0.09	20
133	<0.2	0.53	15	410	<0.5	<2	>15.00	0.5	1	26	17	0.81	<10	1	0.17	<10
134	<0.2	0.76	15	650	<0.5	<2	>15.00	<0.5	5	25	9	0.75	<10	<1	0.12	30
135	<0.2	0.61	<5	760	<0.5	<2	>15.00	<0.5	7	20	12	0.65	<10	<1	0.14	30
136	<0.2	0.16	15	450	<0.5	<2	>15.00	<0.5	5	17	7	0.38	<10	<1	0.03	30
137	<0.2	0.63	20	340	<0.5	<2	>15.00	<0.5	<1	10	4	0.52	<10	2	0.19	<10
138	<0.2	0.38	<5	280	<0.5	<2	>15.00	1.0	1	17	13	0.47	<10	1	0.09	<10
139	<0.2	0.54	20	440	<0.5	<2	>15.00	<0.5	4	27	8	0.57	<10	<1	0.14	20
140	<0.2	0.34	<5	460	<0.5	<2	>15.00	<0.5	4	26	6	0.34	<10	<1	0.08	20

Appendix A- Analytical results from Coconino National Forest, Arizona.--Continued

Sample Number	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La
141	<0.2	1.36	<5	1790	<0.5	<2	>15.00	0.5	8	32	12	0.82	<10	<1	0.30	20
142	<0.2	1.79	65	310	<0.5	<2	13.81	<0.5	8	22	14	1.17	<10	<1	0.44	30
143	<0.2	0.85	40	420	<0.5	<2	>15.00	<0.5	7	18	12	0.74	<10	1	0.17	20
144	<0.2	0.61	<5	610	<0.5	<2	>15.00	<0.5	5	15	13	0.54	<10	<1	0.12	20
145	<0.2	0.57	15	450	<0.5	<2	>15.00	<0.5	6	18	9	0.63	<10	<1	0.11	30
146	<0.2	0.67	10	260	<0.5	<2	>15.00	<0.5	3	15	13	0.61	<10	5	0.14	20
147	<0.2	0.69	65	90	<0.5	<2	>15.00	<0.5	3	19	20	1.15	<10	<1	0.17	20
148	<0.2	0.56	80	180	<0.5	8	>15.00	<0.5	4	15	21	0.65	<10	4	0.17	20
149	<0.2	1.09	40	210	<0.5	<2	>15.00	<0.5	10	18	13	1.04	<10	<1	0.30	30
150	<0.2	0.82	20	380	<0.5	4	>15.00	<0.5	7	22	9	0.76	<10	1	0.22	20
151	<0.2	1.04	<5	190	<0.5	<2	9.63	<0.5	7	43	10	0.94	<10	<1	0.23	20
152	<0.2	1.79	20	1210	<0.5	<2	>15.00	<0.5	9	25	12	1.25	<10	3	0.31	30
153	<0.2	1.25	<5	590	<0.5	<2	>15.00	<0.5	8	28	6	0.89	<10	<1	0.25	30
154	<0.2	0.83	45	400	<0.5	<2	>15.00	<0.5	7	15	6	0.59	<10	5	0.16	20
155	<0.2	1.63	20	640	<0.5	<2	>15.00	<0.5	6	27	8	1.03	<10	<1	0.29	20
156	<0.2	1.53	15	210	<0.5	<2	>15.00	<0.5	6	29	13	1.05	<10	<1	0.34	30
157	<0.2	0.58	285	220	<0.5	<2	>15.00	<0.5	5	23	7	1.89	<10	7	0.09	20
158	<0.2	1.67	10	970	<0.5	<2	>15.00	<0.5	8	26	11	1.20	<10	2	0.27	30
159	<0.2	0.45	65	150	<0.5	<2	>15.00	<0.5	3	14	9	0.49	<10	<1	0.08	20
160	<0.2	0.42	85	300	<0.5	<2	>15.00	<0.5	4	16	13	1.13	<10	<1	0.10	30
161	<0.2	0.49	<5	230	<0.5	2	13.22	<0.5	1	14	9	0.42	<10	1	0.14	20
162	<0.2	1.12	<5	180	<0.5	<2	>15.00	<0.5	9	24	17	0.80	<10	<1	0.20	20
163	<0.2	0.87	5	310	<0.5	<2	>15.00	<0.5	3	23	15	0.56	<10	5	0.19	30
164	<0.2	1.73	5	460	<0.5	<2	8.33	<0.5	8	31	19	1.35	<10	<1	0.34	20
165	<0.2	1.39	<5	630	<0.5	<2	>15.00	0.5	5	27	15	0.89	<10	<1	0.27	30
166	<0.2	0.47	<5	390	<0.5	<2	>15.00	<0.5	4	16	14	0.40	<10	3	0.11	20
167	<0.2	0.72	<5	530	<0.5	<2	>15.00	<0.5	3	17	10	0.54	<10	<1	0.13	30
168	<0.2	0.61	5	610	<0.5	<2	>15.00	<0.5	5	20	9	0.44	<10	<1	0.08	30
169	<0.2	1.27	<5	1140	<0.5	<2	>15.00	<0.5	9	25	16	0.83	<10	9	0.23	30
170	<0.2	0.83	5	410	<0.5	<2	>15.00	<0.5	3	12	12	0.56	<10	<1	0.13	20
171	<0.2	0.47	<5	420	<0.5	<2	>15.00	<0.5	2	19	12	0.40	<10	7	0.07	20
172	<0.2	0.95	<5	490	<0.5	<2	>15.00	<0.5	6	22	15	0.84	<10	<1	0.15	30
173	<0.2	1.66	25	410	<0.5	<2	>15.00	<0.5	7	27	17	1.47	<10	<1	0.29	30
174	<0.2	1.09	<5	220	<0.5	<2	>15.00	<0.5	9	34	16	0.91	<10	<1	0.23	20
175	<0.2	0.62	15	280	<0.5	<2	>15.00	<0.5	4	23	10	0.55	<10	<1	0.12	30

Appendix A- Analytical results from Coconino National Forest, Arizona.--Continued

Sample Number	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La
176	<0.2	0.85	<5	270	<0.5	<2	>15.00	0.5	1	17	10	0.56	<10	3	0.16	20
177	<0.2	0.97	<5	470	<0.5	<2	>15.00	<0.5	3	26	11	0.82	<10	<1	0.17	20
178	<0.2	1.02	<5	200	<0.5	<2	>15.00	<0.5	10	32	12	0.80	<10	<1	0.20	20
179	0.2	0.38	5	10	<0.5	<2	5.17	<1.0	<1	24	<1	0.65	20	<1	0.22	20
180	<0.2	0.01	60	40	0.5	<2	>15.00	<0.5	1	<1	10	0.04	<10	<1	<0.01	<10
181	<0.2	0.01	50	200	<0.5	<2	>15.00	<0.5	1	<1	22	0.02	<10	<1	<0.01	<10
183	0.2	0.18	<5	20	<0.5	12	>15.00	<1.0	<1	6	3	0.13	90	<1	0.03	50
188	<0.2	0.84	<5	30	<0.5	<2	>15.00	<0.5	9	91	55	0.99	<10	1	0.23	20
189	<0.2	1.36	<5	110	<0.5	2	0.99	<0.5	19	27	35	3.67	<10	<1	0.09	20
190	0.8	0.30	20	10	<0.5	4	0.97	<0.5	<1	50	1	0.32	10	<1	0.08	<10
191	0.4	0.33	<5	10	<0.5	<2	0.01	<0.5	<1	53	<1	0.33	10	<1	0.11	<10
192	2.0	2.36	30	300	<0.5	4	1.79	<0.5	24	66	75	4.82	20	<1	0.13	70
193	6.2	0.9	4705	7280	4.0	<2	11.06	2.0	113	19	256	4.59	50	<1	1.02	40
194	52.0	0.91	7320	>10000	11.5	<2	3.37	2.0	461	9	759	5.8	30	<1	2.95	30
195	76.4	1.31	4830	>10000	16.0	<2	0.41	9.0	1531	5	827	0.97	20	<1	3.19	50
196	<0.2	1.00	1195	>10000	4.5	<2	2.56	<0.5	498	27	243	1.31	<10	10	1.23	30
197	<0.2	1.01	2280	>10000	5.5	<2	0.22	<0.5	422	48	298	6.77	<10	7	1.84	30
198	<0.2	1.18	2750	>10000	11.0	62	0.25	<0.5	540	41	500	2.31	<10	11	2.98	60
199	<0.2	1.31	3840	180	<0.5	6	0.23	<1.0	30	68	62	>15.00	20	2	0.15	10
200	<0.2	1.13	7290	340	<0.5	<2	0.42	<1.0	32	50	95	>15.00	20	3	0.11	10
201	0.2	0.64	45	70	<0.5	2	10.4	<1.0	2	7	3	1.23	40	7	0.25	40
202	<0.2	0.07	15	<10	0.5	8	>15.00	1.0	<1	3	<1	0.07	90	<1	<0.01	50
203	<0.2	1.59	3455	>10000	11.5	116	0.13	<0.5	600	17	640	2.57	<10	10	3.74	60
204	<0.2	1.95	4360	>10000	13.5	152	0.21	<0.5	715	22	637	2.65	<10	16	3.99	60
205	83.2	1.12	3460	>10000	18.0	<2	0.35	<1.0	1492	13	1198	0.63	30	<1	3.16	60
206	<0.2	0.14	<5	50	<0.5	12	0.11	<1.0	3	25	3	0.16	<10	2	0.03	<10
207	<0.2	0.25	35	<10	<0.5	28	11.06	<1.0	<1	29	<1	0.33	40	<1	0.09	30
208	<0.2	0.78	>10000	110	<0.5	<2	0.51	<1.0	11	43	37	>15.00	20	8	0.08	10
209	<0.2	3.15	5	380	<0.5	16	2.95	<1.0	31	47	48	3.84	<10	<1	0.41	20
210	<0.2	6.07	<5	1190	<0.5	8	2.64	<1.0	32	29	73	6.54	<10	<1	0.13	60

Appendix A- Analytical results from Chemex Labs Ltd., for samples from Coconino National Forest, Coconino and Yavapai Counties, Arizona.

Sample Number	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Sc	Sr	Ti	Tl	U	V	W	Zn
1	3.89	1140	<1	0.60	80	1550	10	<5	21	313	0.83	10	<10	175	<10	92
2	4.23	1040	<1	0.44	92	2150	2	<5	19	525	0.79	20	<10	68	<10	84
3	1.66	780	<1	0.49	13	820	<2	<5	5	137	0.27	<10	<10	72	<10	50
4	1.76	1480	<1	0.25	1	4480	20	<5	7	65	0.69	40	<10	32	10	132
5	2.45	590	<1	0.31	73	1480	62	<5	4	67	0.31	20	<10	87	<10	54
6	0.05	5	6	0.02	2	130	20	<5	1	225	<0.01	<10	<10	4	<10	4
7	0.25	310	2	0.22	1	240	16	<5	3	600	<0.01	<10	<10	11	<10	28
8	0.11	810	6	0.01	2	240	26	<5	2	186	<0.01	<10	<10	14	<10	22
9	0.43	150	1	0.02	<1	200	14	<5	3	120	<0.01	<10	<10	38	<10	22
10	2.91	570	<1	0.15	131	880	10	<5	3	58	0.19	<10	10	44	<10	54
11	1.66	895	<1	0.13	4	1960	12	<5	5	55	0.62	10	<10	66	<10	72
12	3.96	795	<1	0.69	141	1080	10	<5	8	277	0.43	<10	<10	102	<10	76
13	4.17	3620	13	1.08	104	1350	10	<5	11	450	0.46	50	<10	161	<10	82
14	2.66	>10000	59	0.60	64	1340	10	<5	6	292	0.39	190	<10	168	<10	76
15	2.08	705	<1	0.25	81	3360	2	<5	5	172	0.26	<10	<10	97	<10	60
16	2.90	950	<1	0.65	69	1320	10	<5	6	300	0.42	30	30	108	<10	60
17	0.11	75	<1	0.02	<1	<10	<2	<5	<1	74	<0.01	10	<10	8	20	8
18	0.09	50	<1	0.02	2	<10	<2	<5	1	64	<0.01	<10	<10	8	10	12
19	0.19	495	<1	0.10	4	2360	<2	<5	4	33	0.33	10	<10	40	10	60
20	0.21	580	<1	0.11	1	2580	10	<5	4	38	0.36	20	<10	33	10	76
21	1.72	560	<1	0.22	63	2010	16	<5	6	120	0.22	<10	<10	60	<10	60
22	2.66	4045	12	0.20	96	1530	12	<5	3	86	0.20	80	<10	68	<10	60
23	1.84	330	1	0.16	71	1340	<2	<5	2	62	0.17	<10	<10	60	10	32
27	1.37	710	<1	0.33	42	1820	14	<5	7	185	0.32	<10	<10	75	<10	64
28	2.41	>10000	55	0.34	175	1250	8	<5	2	205	0.21	160	<10	99	<10	56
29	0.12	600	2	0.09	2	140	4	<5	1	13	0.04	<10	<10	3	<10	60
30	0.11	505	2	0.08	1	160	16	<5	1	10	0.03	20	<10	3	<10	70
31	1.96	440	1	0.33	65	1150	14	<5	4	143	0.17	10	<10	64	<10	46
32	4.57	765	<1	0.71	177	1470	<2	<5	9	355	0.38	<10	<10	96	<10	58
33	4.73	750	<1	0.84	185	1360	<2	<5	10	377	0.37	<10	<10	101	<10	58
34	2.71	550	1	0.66	67	930	6	<5	2	236	0.19	20	20	60	<10	36
35	1.86	600	<1	0.43	46	2460	8	<5	4	274	0.20	<10	<10	69	<10	54
36	4.58	970	1	1.46	127	1180	18	<5	16	434	0.57	<10	<10	152	<10	90

Appendix A- Analytical results from Chemex Labs Ltd., for samples from Coconino National Forest, Coconino and Yavapai Counties, Arizona.--Continued

Sample Number	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Sc	Sr	Ti	Tl	U	V	W	Zn
37	4.24	1025	2	1.58	105	1260	22	<5	18	468	0.62	<10	<10	168	<10	94
38	3.74	830	1	0.91	108	860	14	<5	11	296	0.40	<10	<10	119	<10	76
39	4.24	795	3	0.80	124	820	26	<5	8	282	0.39	10	<10	107	10	86
40	2.20	485	1	0.32	35	580	2	<5	4	148	0.12	20	<10	47	<10	40
41	3.56	1060	1	1.51	64	2650	28	<5	17	588	0.42	<10	<10	186	<10	92
42	3.65	810	3	0.85	98	1080	14	5	11	290	0.40	10	10	113	10	74
43	3.58	890	<1	0.76	84	1070	<2	5	11	291	0.49	20	<10	116	<10	82
44	2.65	815	3	0.37	55	1440	<2	5	8	171	0.22	<10	<10	111	30	56
45	3.93	840	1	0.82	107	1040	<2	5	9	282	0.47	10	<10	117	10	78
46	2.74	710	<1	0.48	93	1460	16	<5	8	203	0.29	<10	<10	79	<10	64
47	1.38	220	<1	0.12	51	830	22	<5	2	71	0.11	50	<10	36	<10	26
48	1.36	995	<1	0.16	3	2510	8	<5	8	49	0.51	<10	<10	51	<10	76
49	1.08	540	<1	0.16	45	1850	4	<5	7	45	0.33	40	<10	59	<10	58
51	2.02	1120	2	0.28	14	2900	52	<5	8	72	0.58	20	<10	68	<10	90
52	2.12	1265	<1	0.22	25	3090	8	5	9	177	0.64	10	<10	68	<10	88
53	1.96	1090	3	0.25	29	2710	18	<5	8	90	0.58	10	<10	61	<10	102
54	0.39	515	<1	0.13	16	2940	84	5	3	37	0.15	40	<10	29	<10	62
55	1.76	280	<1	0.14	61	610	20	<5	2	75	0.08	10	10	25	10	36
56	9.77	130	<1	0.03	<1	990	30	<5	1	80	<0.01	<10	<10	20	20	14
57	11.72	85	5	0.02	<1	270	18	10	<1	64	<0.01	<10	<10	27	<10	8
58	8.13	130	7	0.04	<1	680	2	10	<1	72	<0.01	<10	<10	18	20	16
60	0.03	10	1	0.01	<1	100	<2	5	<1	4	<0.01	<10	<10	2	<10	12
61	9.94	45	1	0.05	3	1280	<2	<5	1	76	<0.01	<10	<10	24	10	62
63	0.02	55	<1	0.01	3	50	10	<5	1	4	<0.01	10	<10	11	<10	<2
64	0.08	120	<1	0.03	1	40	<2	<5	1	6	<0.01	10	10	7	<10	<2
65	0.02	70	<1	0.01	1	<10	<2	<5	<1	4	<0.01	10	<10	7	<10	<2
66	0.03	130	<1	0.01	<1	20	8	<5	1	6	<0.01	10	10	8	<10	2
67	0.03	75	<1	0.01	<1	<10	<2	<5	<1	7	<0.01	10	10	5	<10	6
68	0.02	100	<1	0.01	<1	10	<2	<5	1	4	<0.01	10	<10	8	<10	<2
69	0.53	265	<1	0.01	8	260	14	<5	3	9	0.01	<10	<10	16	<10	6
70	0.03	325	2	0.01	1	60	4	<5	1	8	<0.01	10	10	7	<10	4
71	0.02	60	<1	0.02	<1	10	28	<5	<1	5	<0.01	10	10	23	<10	26
72	0.02	70	<1	0.01	<1	<10	46	<5	<1	4	<0.01	20	<10	8	<10	18

Appendix A- Analytical results from Chemex Labs Ltd., for samples from Coconino National Forest, Coconino and Yavapai Counties, Arizona.--Continued

Sample Number	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Sc	Sr	Ti	Tl	U	V	W	Zn
73	0.03	1645	12	0.01	2	40	20	<5	1	12	<0.01	20	<10	30	<10	10
74	0.26	290	<1	0.01	<1	140	2	<5	1	10	<0.01	20	<10	16	<10	6
75	0.03	40	1	0.01	4	90	10	<5	<1	4	<0.01	<10	<10	3	10	10
76	0.07	55	<1	0.01	<1	50	4	<5	<1	6	<0.01	20	10	5	<10	6
77	0.10	105	<1	0.02	<1	140	<2	<5	1	8	<0.01	<10	<10	6	<10	16
78	0.17	115	<1	0.01	<1	<10	<2	<5	1	54	<0.01	20	<10	8	10	22
79	10.4	145	<1	0.03	2	<10	<2	<5	1	64	<0.01	<10	<10	23	20	4
80	11.08	125	<1	0.03	3	60	4	5	2	71	<0.01	<10	<10	22	30	<2
81	0.14	105	<1	0.02	<1	<10	<2	<5	1	79	<0.01	<10	10	8	10	12
82	0.55	105	<1	0.04	<1	<10	<2	15	1	184	0.01	<10	<10	25	20	12
83	0.50	80	<1	0.03	<1	<10	<2	10	1	164	<0.01	<10	<10	25	20	14
84	1.14	210	<1	0.03	3	420	2	<5	3	109	0.03	<10	<10	45	10	24
85	0.78	135	<1	0.02	<1	160	2	10	1	155	0.01	<10	<10	57	20	16
86	1.08	110	<1	0.03	<1	140	<2	5	1	161	0.01	<10	<10	59	20	18
87	0.45	60	<1	0.02	<1	<10	8	<5	<1	128	<0.01	<10	<10	12	20	26
88	0.92	210	<1	0.03	<1	280	<2	10	3	130	0.04	<10	<10	70	10	30
89	0.51	215	<1	0.02	<1	110	<2	15	1	73	0.01	<10	<10	16	20	8
90	0.53	55	1	0.03	<1	<10	<2	10	<1	210	<0.01	<10	<10	33	20	18
91	0.69	65	<1	0.03	<1	<10	<2	10	1	213	<0.01	10	<10	21	20	16
92	1.19	160	<1	0.03	13	140	6	5	3	229	0.04	<10	<10	53	10	24
93	1.98	190	<1	0.04	15	410	<2	<5	4	158	0.07	<10	<10	62	10	40
94	1.30	270	<1	0.06	12	230	<2	15	4	124	0.05	<10	<10	71	10	28
95	3.23	295	1	0.11	20	470	18	5	6	424	0.09	<10	10	128	20	50
96	1.11	135	<1	0.02	5	310	4	<5	3	72	0.04	10	<10	39	10	28
97	0.96	260	<1	0.02	1	240	8	5	3	85	0.04	<10	<10	107	10	22
98	1.93	130	<1	0.01	5	130	8	<5	1	284	0.01	<10	<10	68	<10	12
99	1.42	250	<1	0.01	3	120	10	<5	<1	284	<0.01	<10	<10	10	<10	8
100	0.60	190	<1	0.01	2	110	12	<5	<1	219	<0.01	<10	<10	14	<10	6
101	0.98	285	<1	0.02	8	220	10	<5	2	222	0.01	<10	<10	23	<10	14
102	1.05	205	<1	0.05	8	200	8	<5	2	66	0.02	<10	<10	13	<10	18
103	0.76	315	<1	<0.01	5	170	2	<5	2	81	0.02	<10	<10	51	<10	10
104	1.88	145	<1	0.02	6	160	8	<5	1	369	0.01	<10	30	127	<10	12
105	4.40	190	<1	0.02	5	140	6	<5	1	595	0.02	<10	<10	27	<10	14

Appendix A- Analytical results from Chemex Labs Ltd., for samples from Coconino National Forest, Coconino and Yavapai Counties, Arizona.--Continued

Sample Number	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Sc	Sr	Ti	Tl	U	V	W	Zn
106	0.96	205	<1	<0.01	7	240	4	<5	2	64	0.03	<10	<10	38	<10	18
107	0.75	145	<1	0.01	6	180	8	<5	2	76	0.02	<10	<10	40	<10	12
108	1.12	175	<1	0.01	14	330	6	<5	4	97	0.04	<10	<10	41	<10	32
109	1.59	300	<1	0.17	9	270	10	<5	4	264	0.03	<10	<10	23	<10	34
110	5.72	75	<1	0.09	4	120	10	<5	1	943	0.02	<10	100	52	<10	14
111	5.67	55	<1	0.02	1	30	8	<5	<1	730	0.01	<10	80	36	<10	6
112	0.45	245	<1	0.01	3	50	<2	<5	<1	222	<0.01	20	50	11	<10	14
113	0.77	270	<1	0.02	8	250	4	<5	2	118	0.02	30	20	34	<10	22
114	1.66	310	<1	0.02	14	430	10	<5	4	193	0.04	<10	<10	76	<10	40
115	0.84	315	<1	0.02	3	190	4	10	2	136	0.03	10	<10	23	10	18
116	4.21	185	<1	0.06	<1	230	<2	10	2	451	0.02	<10	20	52	20	18
117	2.16	335	1	0.03	5	240	8	5	3	430	0.04	10	<10	44	20	22
118	2.81	200	<1	0.03	<1	80	2	<5	1	672	0.01	<10	70	114	20	14
119	4.46	170	<1	0.04	4	180	4	5	2	766	0.03	<10	<10	51	10	16
120	0.79	235	<1	0.02	<1	120	<2	10	2	174	0.02	<10	10	26	20	14
121	3.84	205	1	0.06	4	270	<2	5	3	587	0.04	<10	<10	45	10	32
122	4.07	110	<1	0.06	3	110	<2	5	1	759	0.02	20	<10	28	10	14
123	0.76	230	<1	0.03	<1	40	8	5	1	465	<0.01	10	<10	12	20	12
124	4.68	135	1	0.03	6	160	16	<5	1	846	0.01	20	40	49	<10	32
125	1.15	295	<1	0.02	4	110	2	<5	1	405	0.01	40	40	17	10	12
126	1.78	270	<1	0.03	<1	110	14	10	1	500	0.01	10	<10	39	20	20
127	4.48	170	<1	0.09	<1	80	<2	10	1	1094	0.01	<10	70	102	30	12
128	3.13	75	<1	0.05	<1	40	<2	5	1	775	0.01	<10	30	72	20	8
129	2.63	190	<1	0.11	<1	260	8	5	3	639	0.04	10	10	118	20	30
130	1.33	150	<1	0.01	7	140	24	<5	2	450	0.02	40	40	48	<10	26
131	2.11	140	<1	0.04	<1	40	<2	10	1	405	0.01	20	<10	42	20	10
132	1.42	110	1	0.03	<1	<10	4	15	1	532	0.01	10	10	36	20	12
133	1.51	290	<1	0.03	4	110	126	5	1	542	0.01	20	40	56	<10	204
134	1.35	180	1	0.03	1	150	<2	15	2	386	0.03	<10	40	61	10	22
135	3.74	240	<1	0.06	<1	110	6	5	1	602	0.01	<10	40	53	20	16
136	0.79	155	<1	0.03	<1	10	6	<5	1	422	<0.01	<10	40	15	20	8
137	2.68	155	<1	0.11	4	100	<2	<5	1	881	0.01	<10	150	77	<10	16
138	0.99	235	<1	0.01	5	90	124	5	<1	358	0.01	20	30	44	<10	98
139	1.24	160	<1	0.02	<1	120	14	<5	1	253	0.01	<10	10	24	10	14

Appendix A- Analytical results from Chemex Labs Ltd., for samples from Coconino National Forest, Coconino and Yavapai Counties, Arizona.--Continued

Sample Number	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Sc	Sr	Ti	Tl	U	V	W	Zn
140	0.71	220	<1	0.02	1	<10	8	5	1	162	<0.01	<10	<10	16	10	16
141	3.84	130	<1	0.05	7	240	20	10	3	437	0.03	<10	<10	42	20	24
142	7.66	215	<1	0.11	4	210	20	5	3	1669	0.05	<10	30	103	30	34
143	6.35	165	<1	0.38	5	110	32	5	2	1002	0.03	<10	60	68	30	18
144	3.24	90	<1	0.07	<1	110	26	10	1	962	0.01	<10	10	35	20	12
145	5.36	170	<1	0.09	<1	120	<2	5	1	963	0.02	<10	50	63	20	14
146	6.79	165	1	0.04	<1	100	<2	10	1	977	0.01	<10	<10	24	20	14
147	5.67	385	<1	0.05	1	190	<2	<5	2	800	0.02	<10	10	71	20	22
148	4.38	135	2	0.07	<1	90	<2	4615	1	588	0.01	<10	<10	32	20	10
149	5.03	285	2	0.10	5	190	<2	<5	2	532	0.03	10	90	81	20	22
150	3.22	155	<1	0.03	<1	170	16	5	2	422	0.03	<10	<10	40	10	20
151	1.61	175	<1	0.02	9	170	<2	10	3	298	0.04	10	<10	41	10	20
152	4.27	395	<1	0.08	1	300	4	5	3	756	0.05	<10	10	45	20	28
153	1.07	125	<1	0.03	2	230	32	<5	2	105	0.03	<10	<10	40	10	30
154	5.16	100	1	0.12	<1	90	4	10	2	895	0.02	<10	50	78	20	14
155	1.15	295	<1	0.04	4	240	16	5	3	106	0.04	10	<10	51	10	34
156	1.69	265	<1	0.03	7	320	<2	5	3	386	0.03	<10	<10	44	10	32
157	0.75	900	<1	0.02	9	210	12	10	1	148	0.02	<10	<10	280	20	14
158	1.25	255	<1	0.03	11	190	<2	5	3	177	0.05	<10	<10	49	10	28
159	2.15	130	2	0.12	<1	100	16	15	1	320	0.01	<10	10	65	20	12
160	3.18	345	<1	0.03	<1	170	<2	5	1	485	0.01	10	10	153	20	18
161	3.22	90	<1	0.05	<1	120	<2	5	1	318	0.01	<10	<10	118	10	28
162	1.01	185	<1	0.03	5	140	10	10	2	90	0.03	<10	<10	39	10	28
163	0.84	120	<1	0.03	<1	100	8	10	2	82	0.02	10	<10	37	10	20
164	1.51	230	<1	0.04	8	390	4	15	4	92	0.07	10	<10	77	20	40
165	1.10	170	<1	0.03	4	190	16	15	3	176	0.03	<10	<10	33	20	24
166	4.91	100	<1	0.04	<1	40	26	15	1	590	0.01	10	<10	24	20	12
167	3.72	100	<1	0.03	<1	120	8	5	1	525	0.02	10	10	35	20	18
168	1.12	95	<1	0.03	<1	30	6	10	1	343	0.01	<10	<10	59	20	14
169	0.84	200	<1	0.02	3	170	<2	10	2	151	0.03	<10	<10	27	10	22
170	2.97	110	1	0.04	2	170	20	<5	1	437	0.02	<10	<10	27	10	22
171	0.92	65	2	0.33	<1	20	<2	15	1	324	0.01	10	10	23	20	20
172	0.79	225	<1	0.03	2	110	6	15	2	255	0.03	<10	<10	33	20	26

Appendix A- Analytical results from Chemex Labs Ltd., for samples from Coconino National Forest, Coconino and Yavapai Counties, Arizona.--Continued

Sample Number	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Sc	Sr	Ti	Tl	U	V	W	Zn
173	1.87	330	<1	0.03	8	210	18	5	3	427	0.06	<10	<10	95	20	36
174	1.38	175	2	0.03	5	230	<2	<5	3	188	0.04	<10	10	81	20	26
175	0.72	145	<1	0.02	2	90	2	5	1	223	0.02	20	<10	21	30	18
176	0.83	85	<1	0.03	3	130	2	15	2	223	0.02	<10	<10	36	10	20
177	0.73	165	2	0.02	2	180	34	5	2	85	0.03	10	<10	22	10	24
178	0.65	165	<1	0.02	1	140	4	15	2	99	0.02	<10	<10	27	10	26
179	2.79	180	<1	0.02	5	<10	4	<5	2	18	<0.01	20	<10	17	<10	2
180	0.45	5	1	0.02	4	40	<2	10	<1	65	<0.01	<10	<10	1	<10	230
181	0.51	5	1	0.02	18	<10	<2	15	<1	316	<0.01	<10	<10	12	<10	100
183	0.47	85	<1	0.02	5	20	<2	5	1	231	<0.01	10	<10	10	10	2
188	10.80	445	<1	0.05	25	350	2	10	2	590	0.05	<10	<10	261	30	26
189	0.33	835	<1	0.23	33	1070	4	<5	9	103	0.19	<10	<10	53	<10	48
190	0.03	15	<1	0.01	<1	130	4	<5	1	20	<0.01	50	10	7	10	6
191	0.02	5	<1	<0.01	1	170	34	<5	1	4	<0.01	50	<10	5	10	12
192	2.03	765	1	0.61	80	3410	14	5	2	490	0.29	50	<10	156	<10	72
193	0.24	>10000	613	0.03	34	1220	234	10	3	274	0.01	1700	70	800	60	298
194	0.11	>10000	2033	0.07	42	750	380	10	5	961	<0.01	4810	210	1853	150	666
195	0.14	>10000	2103	0.11	154	560	116	<5	3	1432	0.01	6530	250	863	130	832
196	0.15	>10000	909	0.05	105	670	48	<5	1	425	0.01	2130	<10	605	10	354
197	0.18	>10000	1221	0.04	83	770	148	<5	2	475	0.01	3850	<10	1014	<10	358
198	0.19	>10000	1971	0.06	135	930	158	<5	2	835	<0.01	6620	<10	1900	20	544
199	0.13	1750	81	0.02	51	1080	100	10	9	31	0.01	10	<10	906	100	458
200	0.17	1870	142	0.02	53	1010	112	20	11	60	0.01	40	<10	1641	100	770
201	0.13	640	2	0.02	<1	560	6	<5	3	32	0.02	<10	<10	37	<10	12
202	0.22	55	<1	0.04	<1	<10	<2	<5	1	346	<0.01	<10	<10	7	20	6
203	0.14	>10000	1541	0.04	392	780	82	<5	4	877	<0.01	6480	<10	1072	90	444
204	0.15	>10000	2057	0.05	714	910	94	<5	5	976	<0.01	7340	<10	1295	100	474
205	0.19	>10000	3067	0.16	99	400	54	<5	2	1787	0.02	2650	270	1457	170	266
206	0.02	430	2	0.01	<1	<10	<2	<5	<1	6	<0.01	10	<10	5	<10	<2
207	6.10	70	5	0.03	<1	1960	<2	<5	1	31	<0.01	<10	<10	19	10	32
208	0.11	975	183	0.02	43	1310	154	35	18	71	0.01	10	<10	1224	2100	566
209	2.97	990	<1	0.66	184	900	10	<5	10	305	0.47	10	<10	99	20	44
210	4.83	1135	<1	0.30	172	1620	<2	<5	12	1870	0.68	<10	<10	109	40	72

Appendix B- Analytical results for samples from Coconino National Forest, Arizona.

[Analyses by Bondar-Clegg Inc., Sparks, NV.; neutron activation method; Au, Ir ppb; Fe, Na %; all other units ppm; samples 24-26, 50, 59, 62, 182, and 184-187 are clay, lava, and pumice samples and do not appear in this appendix]

Sample Number	Ag	As	Au	Ba	Br	Cd	Ce	Co	Cr	Cs	Eu	Fe	Hf	Ir	La	Lu
1	<5	<1	<5	600	<1	<10	57	54	97	<1	<2	8.3	3	<100	29	<0.5
2	<5	<1	<5	620	<1	<10	47	46	150	<1	<2	7.4	3	<100	25	<0.5
3	<5	1	<5	540	<1	<10	54	58	<50	<1	2	9.3	4	<100	32	<0.5
4	<5	2	<5	1100	<1	<10	140	20	<50	<1	3	9.1	7	<100	59	<0.5
5	<5	<1	<5	590	<1	<10	63	54	250	<1	<2	7.8	4	<100	30	<0.5
6	<5	53	<5	810	<1	<10	100	<10	95	1	<2	1.0	4	<100	57	<0.5
7	<5	13	<5	1000	<1	<10	78	<10	66	3	<2	1.4	4	<100	50	<0.5
8	<5	35	<5	660	1	<10	110	<10	60	2	<2	1.8	8	<100	64	<0.5
9	<5	18	<5	970	3	<10	140	<10	<50	3	<2	1.0	13	<100	80	0.6
10	<5	3	<5	840	<1	<10	83	57	530	<1	4	6.5	4	<100	46	<0.5
11	<5	2	<5	720	<1	<10	77	30	<50	<1	<2	8.0	5	<100	49	0.6
12	<5	2	<5	540	<1	<10	67	65	510	<1	<2	7.6	3	<100	42	<0.5
13	<5	38	<5	900	<1	<10	85	69	210	<1	<2	7.7	2	<100	50	<0.5
14	<5	130	<5	1500	<1	<10	84	81	120	<1	<2	8.7	4	<100	49	<0.5
15	<5	2	<5	1400	<1	<10	170	55	340	<1	3	6.4	4	<100	110	<0.5
16	<5	4	<5	630	<1	<10	77	58	170	<1	2	8.5	4	<100	46	<0.5
17	<5	<1	<5	<100	<1	<10	<10	<10	<50	<1	<2	<0.5	<2	<100	<5	<0.5
18	<5	12	<5	<100	1	<10	<10	<10	<50	<1	<2	<0.5	<2	<100	<5	<0.5
19	<5	5	<5	1200	<1	<10	120	11	<50	<1	<2	5.4	6	<100	56	<0.5
20	<5	9	<5	1300	1	<10	130	12	<50	<1	<2	4.8	7	<100	58	<0.5
21	<5	3	<5	910	<1	<10	91	57	330	1	4	6.7	3	<100	56	<0.5
22	<5	37	<5	1300	<1	<10	120	64	650	<1	2	6.4	3	<100	72	<0.5
23	<5	2	<5	1000	<1	<10	82	51	520	<1	2	6.5	3	<100	41	<0.5
27	<5	3	<5	910	<1	<10	100	39	95	1	<2	6.5	6	<100	58	<0.5
28	<5	175	<5	1700	<1	<10	88	93	580	<1	2	8.7	4	<100	48	<0.5
29	5	4	<5	1400	<1	<10	100	<10	<50	<1	<2	1.9	6	<100	61	<0.5
30	<5	6	<5	1400	1	<10	100	<10	<50	1	2	1.9	6	<100	63	<0.5
31	<5	2	<5	980	<1	<10	140	57	340	<1	3	6.8	4	<100	82	<0.5
32	<2	0.8	4	930	<0.5	<5	110.0	62	1700	<0.5	<1	7.3	3	<50	43	0.3
33	<2	0.8	<2	940	<0.5	<5	110.0	63	1700	<0.5	1	7.4	4	<50	44	0.3
34	6	1	<5	750	<1	<10	55	53	330	<1	<2	6.9	3	<100	37	<0.5

Appendix B-Analytical results for samples from Coconino National Forest, Arizona--Continued.

Sample Number	Ag	As	Au	Ba	Br	Cd	Ce	Co	Cr	Cs	Eu	Fe	Hf	Ir	La	Lu
35	<5	2	<5	990	<1	<10	110	43	78	1	<2	5.7	4	<100	70	<0.5
36	<5	1	<5	530	<1	<10	55	73	300	<1	<2	8.3	3	<100	30	<0.5
37	<5	2	<5	440	1	<10	48	60	210	<1	<2	7.8	3	<100	30	<0.5
38	<5	2	<5	410	<1	<10	48	69	270	<1	<2	8.5	3	<100	32	<0.5
39	<5	1	<5	530	<1	<10	51	69	280	<1	<2	7.7	3	<100	29	<0.5
40	<5	1	<5	890	<1	<10	66	45	67	1	<2	6.8	3	<100	41	<0.5
41	<5	<1	140	1400	<1	<10	180	57	220	<1	<2	7.4	3	<100	120	<0.5
42	<5	<1	<5	670	<1	<10	65	61	230	<1	2	8.1	4	<100	37	<0.5
43	<5	1	<5	560	<1	<10	65	53	240	<1	<2	8.4	5	<100	31	<0.5
44	<5	<1	<5	500	2	<10	49	54	76	<1	<2	8.9	4	<100	25	<0.5
45	<5	<1	<5	550	<1	<10	67	58	310	<1	<2	8.4	4	<100	30	<0.5
46	<5	2	<5	640	<1	<10	75	58	300	<1	<2	7.2	3	<100	44	<0.5
47	<5	<1	<5	930	<1	<10	76	40	200	<1	<2	6.6	5	<100	37	<0.5
48	<5	1	<5	590	<1	<10	79	39	<50	1	<2	>10.0	5	<100	44	<0.5
49	<5	2	<5	560	<1	<10	59	47	230	<1	2	8.7	5	<100	28	<0.5
51	<5	6	<5	1500	<1	<10	71	23	99	<1	3	8.2	3	<100	32	<0.5
52	<5	1	<5	1500	<1	<10	74	26	74	<1	2	8.3	4	<100	32	<0.5
53	<5	4	<5	1500	<1	<10	71	28	110	<1	<2	8.3	3	<100	32	<0.5
54	<5	3	<5	1500	<1	<10	82	34	100	<1	3	8.4	4	<100	33	<0.5
55	<5	2	<5	700	<1	<10	66	46	300	<1	<2	7.0	3	<100	31	<0.5
56	<5	2	<5	<100	2	<10	<10	<10	59	<1	<2	<0.5	3	<100	7	<0.5
57	<5	<1	<5	<100	<1	<10	<10	<10	<50	<1	<2	<0.5	<2	<100	<5	<0.5
58	<5	4	<5	110	2	<10	18	<10	61	2	<2	<0.5	3	<100	8	<0.5
60	<5	<1	<5	<100	<1	<10	<10	<10	69	<1	<2	<0.5	4	<100	<5	<0.5
61	<5	6	<5	<100	2	<10	13	<10	<50	<1	<2	<0.5	3	<100	10	<0.5
63	<5	4	<5	250	<1	<10	28	<10	100	1	<2	0.7	7	<100	10	<0.5
64	<5	11	<5	220	<1	<10	17	<10	120	1	<2	<0.5	4	<100	6	<0.5
65	<5	6	<5	110	<1	<10	11	<10	110	<1	<2	<0.5	3	<100	5	<0.5
66	<5	10	<5	220	<1	<10	21	<10	120	2	<2	0.5	7	<100	8	<0.5
67	<5	10	<5	<100	<1	<10	<10	<10	130	<1	<2	<0.5	<2	<100	<5	<0.5
68	<5	10	<5	200	<1	<10	18	<10	110	2	<2	0.6	7	<100	8	<0.5
69	<5	10	<5	300	<1	<10	49	<10	89	5	<2	1.3	9	<100	21	<0.5
70	<5	10	<5	190	<1	<10	17	<10	120	<1	<2	<0.5	8	<100	7	<0.5

Appendix B-Analytical results for samples from Coconino National Forest, Arizona--Continued.

Sample Number	Ag	As	Au	Ba	Br	Cd	Ce	Co	Cr	Cs	Eu	Fe	Hf	Ir	La	Lu
71	<5	26	<5	100	<1	<10	13	<10	110	<1	<2	0.6	2	<100	6	<0.5
72	<5	13	<5	120	<1	<10	13	<10	110	<1	<2	<0.5	4	<100	6	<0.5
73	<5	31	<5	220	<1	<10	15	<10	100	<1	<2	0.6	9	<100	6	<0.5
74	<5	20	<5	210	<1	<10	21	<10	120	1	<2	0.6	13	<100	10	<0.5
75	<5	5	<5	180	<1	<10	<10	<10	90	<1	<2	<0.5	<2	<100	<5	<0.5
76	<5	3	<5	180	<1	<10	12	<10	100	<1	<2	<0.5	4	<100	6	<0.5
77	<5	4	<5	220	<1	<10	12	<10	62	1	<2	<0.5	6	<100	5	<0.5
78	<5	2	<5	<100	<1	<10	<10	<10	<50	<1	<2	<0.5	<2	<100	<5	<0.5
79	<5	4	6	<100	3	<10	14	<10	<50	1	<2	0.8	<2	<100	6	<0.5
80	<5	8	<5	<100	3	<10	16	<10	<50	2	<2	0.7	<2	<100	6	<0.5
81	<5	2	<5	<100	2	<10	<10	<10	<50	<1	<2	<0.5	<2	<100	<5	<0.5
82	<5	5	<5	260	15	<10	<10	<10	<50	2	<2	<0.5	<2	<100	<5	<0.5
83	<5	6	<5	290	13	<10	<10	<10	<50	1	<2	<0.5	<2	<100	<5	<0.5
84	<5	3	<5	570	3	<10	34	<10	63	3	<2	1.0	5	<100	14	<0.5
85	<5	4	<5	290	6	<10	13	<10	<50	2	<2	<0.5	<2	<100	<5	<0.5
86	<5	12	<5	540	10	<10	10	<10	<50	2	<2	<0.5	<2	<100	<5	<0.5
87	<5	7	<5	240	10	<10	<10	<10	<50	<1	<2	<0.5	<2	<100	<5	<0.5
88	<5	9	<5	1600	10	<10	22	<10	<50	2	<2	1.1	3	<100	14	<0.5
89	<5	2	<5	160	3	<10	13	<10	<50	<1	<2	<0.5	<2	<100	<5	<0.5
90	<5	6	<5	360	22	<10	<10	<10	<50	1	<2	<0.5	<2	<100	<5	<0.5
91	<5	5	<5	570	15	<10	<10	<10	<50	1	<2	<0.5	<2	<100	<5	<0.5
92	<5	4	<5	330	20	<10	20	<10	<50	2	<2	1.1	<2	<100	10	<0.5
93	<5	4	<5	510	7	<10	32	<10	79	2	<2	1.3	8	<100	14	<0.5
94	<5	4	<5	460	15	<10	26	<10	63	2	<2	1.5	6	<100	14	<0.5
95	<5	30	<5	1000	7	<10	36	14	60	7	<2	1.2	4	<100	22	0.6
96	<5	14	<5	350	2	<10	25	<10	75	6	<2	0.7	8	<100	12	<0.5
97	<5	6	<5	430	1	<10	19	<10	64	2	<2	0.9	6	<100	12	<0.5
98	<2	45.0	<2	760	7.1	<5	21.0	<5	21	2.4	<1	0.7	2	<50	7	<0.2
99	<2	19.0	<2	260	3.6	<5	<5.0	<5	<20	2.0	<1	0.4	<1	<50	3	<0.2
100	<2	7.0	<2	320	7.0	<5	8.4	<5	35	3.1	<1	0.3	<1	<50	3	<0.2
101	<2	78.3	<2	330	1.2	<5	23.0	6	50	2.0	<1	1.0	4	<50	9	<0.2
102	<2	5.4	<2	480	4.6	<5	31.0	<5	54	3.3	<1	1.0	2	<50	15	<0.2
103	<2	12.0	3	380	0.5	<5	27.0	<5	88	0.9	<1	0.6	4	<50	12	<0.2
104	<2	54.9	3	<180	2.3	<5	25.0	<5	38	2.2	<1	0.7	2	<50	7	<0.2
105	<2	16.0	<2	530	8.1	<5	18.0	<5	45	3.1	<1	0.7	2	<50	9	<0.2

Appendix B-Analytical results for samples from Coconino National Forest, Arizona--Continued.

Sample Number	Ag	As	Au	Ba	Br	Cd	Ce	Co	Cr	Cs	Eu	Fe	Hf	Ir	La	Lu
106	<2	4.0	2	340	1.1	<5	30.0	6	110	3.8	<1	1.0	6	<50	13	<0.2
107	<2	2.5	<2	250	<0.5	<5	25.0	<5	79	1.5	<1	0.7	4	<50	14	<0.2
108	<2	8.6	3	610	5.8	<5	45.0	6	99	9.5	<1	1.9	6	<50	21	0.2
109	<2	11.0	4	1700	4.4	<5	57.0	8	110	10.0	<1	1.6	3	<50	24	<0.2
110	<2	11.0	<2	<410	14.0	<5	43.0	<5	54	11.0	<1	0.8	2	<50	9	<0.2
111	<2	11.0	<2	<430	5.3	<5	<19.0	<5	30	4.8	<1	0.4	1	<50	4	<0.2
112	<5	5	<5	<100	7	<10	<10	<10	<50	<1	<2	<0.5	<2	<100	<5	<0.5
113	<5	9	<5	470	<1	<10	15	<10	<50	6	<2	0.8	<2	<100	11	<0.5
114	<2	29.0	<2	320	1.0	<5	56.0	8	79	5.6	<1	2.0	3	<50	23	<0.2
115	<5	5	<5	310	6	<10	24	<10	56	3	<2	0.8	<2	<100	10	<0.5
116	<5	15	<5	210	5	<10	19	<10	<50	6	<2	0.9	3	<100	10	1.6
117	<5	9	<5	550	5	<10	27	<10	<50	3	<2	1.3	4	<100	12	<0.5
118	<5	13	<5	250	2	<10	<10	<10	<50	2	<2	0.7	<2	<100	<5	<0.5
119	<5	13	<5	390	7	<10	21	<10	<50	4	<2	0.7	<2	<100	8	<0.5
120	<5	3	<5	170	<1	<10	13	<10	<50	2	<2	<0.5	<2	<100	7	<0.5
121	<5	11	<5	400	24	<10	33	<10	54	5	<2	1.1	4	<100	14	<0.5
122	<5	6	<5	460	18	<10	16	<10	<50	2	<2	0.7	3	<100	8	<0.5
123	<5	9	<5	450	10	<10	<10	<10	<50	2	<2	<0.5	<2	<100	<5	<0.5
124	<5	27	<5	560	8	<10	16	<10	<50	6	<2	0.9	<2	<100	10	<0.5
125	<5	8	<5	260	15	<10	10	<10	<50	7	<2	0.9	<2	<100	6	<0.5
126	<5	10	<5	390	4	<10	<10	<10	<50	5	<2	0.5	<2	<100	<5	<0.5
127	<5	31	<5	<240	6	<10	<10	<10	<50	5	<2	<0.5	<2	<100	<5	<0.5
128	<5	24	<5	<100	3	<10	15	<10	<50	3	<2	<0.5	<2	<100	<5	<0.5
129	<5	19	<5	460	19	<10	19	<10	<50	11	<2	0.9	<2	<100	10	<0.5
130	<5	9	<5	120	12	<10	11	<10	<50	7	<2	0.9	<2	<100	11	<0.5
131	<5	6	6	570	6	<10	15	<10	<50	4	<2	<0.5	<2	<100	<5	<0.5
132	<5	4	<5	6000	9	<10	12	<10	<50	5	<2	<0.5	<2	<100	<5	<0.5
133	<5	21	6	300	9	<10	<10	<10	<50	6	<2	0.9	<2	<100	7	<0.5
134	<5	7	<5	430	4	<10	<10	<10	<50	7	<2	0.7	<2	<100	7	<0.5
135	<5	10	<5	570	2	<10	11	<10	<50	3	<2	0.6	<2	<100	6	<0.5
136	<5	8	<5	300	7	<10	<10	<10	<50	1	<2	<0.5	<2	<100	<5	<0.5
137	<5	25	<5	<500	25	<10	<22	<10	<50	9	<2	0.7	<2	<100	7	<0.5
138	<5	7	6	170	8	<10	<10	<10	<50	3	<2	0.6	<2	<100	<5	<0.5
139	<5	9	<5	540	<1	<10	17	<10	<50	4	<2	0.6	4	<100	6	<0.5
140	<5	4	<5	560	<1	<10	15	<10	<50	2	<2	<0.5	3	<100	<5	<0.5

Appendix B-Analytical results for samples from Coconino National Forest, Arizona--Continued.

Sample Number	Ag	As	Au	Ba	Br	Cd	Ce	Co	Cr	Cs	Eu	Fe	Hf	Ir	La	Lu
141	<5	10	<5	1900	12	<10	25	<10	54	5	<2	0.7	4	<100	11	<0.5
142	<5	19	<5	200	6	<10	14	<10	<50	7	<2	0.9	4	<100	11	<0.5
143	<5	27	<5	<100	26	<10	<10	<10	<50	7	<2	0.7	<2	<100	6	<0.5
144	<5	18	<5	610	15	<10	<10	<10	<50	2	<2	<0.5	<2	<100	<5	<0.5
145	<5	16	<5	260	10	<10	<10	<10	<50	7	<2	0.6	<2	<100	<5	<0.5
146	<5	5	<5	310	8	<10	10	<10	<50	9	<2	<0.5	<2	<100	5	<0.5
147	<5	43	<5	<100	1	<10	17	<10	<50	2	<2	1.1	3	<100	8	<0.5
148	<5	29	<5	200	10	<10	<10	<10	<50	3	<2	0.6	<2	<100	6	<0.5
149	<5	38	<5	<330	18	<10	<10	<10	<50	5	<2	0.9	<2	<100	7	<0.5
150	<5	10	<5	430	4	<10	17	<10	<50	4	<2	0.8	2	<100	10	<0.5
151	<5	13	<5	300	4	<10	20	<10	63	3	<2	0.9	4	<100	8	<0.5
152	<5	9	<5	1300	29	<10	24	<10	<50	3	<2	1.1	<2	<100	11	<0.5
153	<5	5	<5	690	2	<10	22	<10	<50	5	<2	1.0	3	<100	14	<0.5
154	<5	45	<5	240	14	<10	18	<10	<50	6	<2	0.5	<2	<100	7	<0.5
155	<5	5	<5	760	3	<10	23	<10	57	8	<2	1.0	5	<100	13	<0.5
156	<5	21	<5	400	9	<10	28	<10	62	9	<2	1.2	3	<100	13	<0.5
157	<5	264	<5	220	<1	<10	11	<10	<50	2	<2	1.9	<2	<100	<5	<0.5
158	<5	10	<5	1100	8	<10	34	<10	57	9	<2	1.2	6	<100	14	<0.5
159	<5	42	<5	120	8	<10	<10	<10	<50	3	<2	<0.5	<2	<100	<5	<0.5
160	<5	94	<5	270	2	<10	15	<10	<50	4	<2	1.1	<2	<100	6	<0.5
161	<5	18	<5	340	<1	<10	18	<10	<50	2	<2	<0.5	3	<100	6	<0.5
162	<5	6	<5	330	1	<10	20	<10	<50	6	<2	0.9	4	<100	11	<0.5
163	<5	4	<5	390	<1	<10	22	<10	<50	4	<2	0.6	3	<100	10	<0.5
164	<5	8	<5	690	3	<10	37	<10	59	3	<2	1.3	6	<100	15	<0.5
165	<5	5	<5	740	5	<10	16	<10	<50	3	<2	0.9	<2	<100	11	<0.5
166	<5	4	<5	410	4	<10	<10	<10	<50	2	<2	<0.5	<2	<100	5	<0.5
167	<5	4	<5	600	7	<10	12	<10	<50	3	<2	<0.5	<2	<100	5	<0.5
168	<5	5	<5	690	15	<10	<10	<10	<50	3	<2	<0.5	<2	<100	5	<0.5
169	<5	4	<5	1200	8	<10	22	<10	51	3	<2	0.7	2	<100	8	<0.5
170	<5	7	<5	450	13	<10	18	<10	<50	3	<2	0.5	<2	<100	8	<0.5
171	<5	6	<5	500	79	<10	<10	<10	<50	2	<2	0.6	<2	<100	<5	<0.5
172	<5	5	<5	550	9	<10	14	<10	<50	3	<2	0.8	<2	<100	6	<0.5
173	<5	7	<5	580	10	<10	30	<10	<50	3	<2	1.3	2	<100	12	<0.5
174	<5	4	<5	360	4	<10	16	<10	<50	3	<2	0.9	4	<100	10	<0.5
175	<5	4	<5	360	11	<10	14	<10	<50	3	<2	0.6	3	<100	7	<0.5

Appendix B-Analytical results for samples from Coconino National Forest, Arizona--Continued.

Sample Number	Ag	As	Au	Ba	Br	Cd	Ce	Co	Cr	Cs	Eu	Fe	Hf	Ir	La	Lu
176	<5	4	<5	470	20	<10	15	<10	<50	3	<2	<0.5	2	<100	7	<0.5
177	<5	5	<5	640	3	<10	19	<10	<50	3	<2	0.8	4	<100	10	<0.5
178	<5	3	<5	350	11	<10	19	<10	<50	2	<2	0.7	3	<100	8	<0.5
179	<5	4	<5	220	2	<10	28	<10	83	3	<2	1.0	10	<100	16	<0.5
180	<5	45	<5	<100	<1	<10	<10	<10	<50	<1	<2	<0.5	<2	<100	<5	<0.5
181	<5	38	<5	210	2	<10	<10	<10	<50	<1	<2	<0.5	<2	<100	<5	<0.5
183	<5	1	<5	<100	2	<10	<10	<10	<50	<1	<2	<0.5	<2	<100	<5	<0.5
188	<5	2	<5	100	4	<10	13	<10	74	4	<2	0.7	<2	<100	8	<0.5
189	<5	2	<5	1000	<1	<10	45	24	110	<1	<2	4.2	<2	<100	25	<0.5
190	<5	3	<5	<100	<1	<10	<10	<10	98	<1	<2	<0.5	<2	<100	<5	<0.5
191	<5	2	<5	<100	<1	<10	13	<10	140	<1	<2	<0.5	12	<100	6	<0.5
192	<5	1	5	1400	<1	<10	180	46	360	<1	2	7.1	4	<100	84	<0.5
193	<5	4600	<5	8100	13	<10	<10	120	<50	5	<2	4.9	<2	<100	11	<0.5
194	<5	6130	<5	18500	12	<10	<10	520	<50	6	<2	5.6	<2	<100	17	0.8
195	<5	4390	<5	20000	8	<10	<10	1740	<50	11	<2	0.8	<2	<100	39	<0.5
196	<5	1180	<5	14000	2	<10	55	630	77	5	<2	1.2	<2	<100	35	<0.5
197	<5	2120	<5	14700	4	<10	28	490	<50	5	<2	5.8	<2	<100	38	0.6
198	<5	2840	<5	20000	6	<10	58	700	160	7	<2	2.5	<2	<100	63	<0.5
199	<5	3760	<5	140	13	<10	36	34	170	7	<2	>10.0	<2	<100	17	<0.5
200	<5	6540	<5	380	15	<10	20	27	<50	11	<2	>10.0	<2	<100	19	1.1
201	<5	37	<5	310	<1	<10	48	<10	65	16	<2	1.6	10	<100	23	<0.5
202	<5	7	<5	<100	<1	<10	<10	<10	<50	2	<2	<0.5	<2	<100	<5	<0.5
203	<5	3280	<5	20000	6	<10	61	710	83	5	<2	2.3	<2	<100	55	<0.5
204	<5	1750	<5	20000	3	<10	93	1020	<50	6	<2	3.2	3	<100	33	<0.5
205	<5	2860	<5	20000	6	<10	110	1410	<50	21	<2	<0.5	<2	<100	40	1.0
206	<5	22	<5	<100	<1	<10	11	<10	110	<1	<2	<0.5	<2	<100	6	<0.5
207	<5	26	<5	<100	1	<10	12	<10	96	1	<2	<0.5	4	<100	14	<0.5
208	<5	>10000	<24	<200	<29	<27	<34	<10	<50	3	<2	>10.0	7	<100	16	1.2
209	<5	11	5	1100	<1	<10	81	55	740	<1	<2	9.0	5	<100	42	<0.5
210	<5	4	<5	1500	1	<10	130	61	570	1	<2	9.3	4	<100	70	<0.5

Appendix B-Analytical results from Bondar-Clegg & Company Ltd., for samples from Coconino National Forest, Coconino and Yavapai Couties, Arizona.--Continued

Sample Number	Mo	Na	Ni	Rb	Sb	Sc	Se	Sm	Sn	Ta	Tb	Te	Th	U	W	Yb	Zn	Zr
1	<2	1.70	91	<10	<0.2	22.0	<10	7.4	<200	2	1	<20	3.2	0.7	<2	<5	<200	<500
2	<2	1.00	83	11	<0.2	21.0	<10	6.1	<200	1	<1	<20	2.3	1.2	<2	<5	<200	<500
3	2	3.00	<50	11	0.3	22.0	<10	6.7	<200	2	<1	<20	3.3	1.1	<2	<5	<200	<500
4	3	2.90	<50	39	0.2	11.0	<10	16.0	<200	3	2	<20	4.8	1.5	<2	<5	230	<500
5	3	2.30	100	16	1.8	25.0	<10	6.8	<200	3	1	<20	4.3	1.2	<2	<5	<200	<500
6	8	0.51	<50	95	0.9	2.0	<10	6.8	<200	1	<1	<20	18.0	5.3	<2	<5	<200	<500
7	4	0.57	<50	95	0.7	3.5	<10	7.3	<200	<1	1	<20	18.0	4.7	<2	<5	<200	<500
8	7	0.41	<50	83	1.4	4.5	<10	6.9	<200	<1	<1	<20	24.0	6.9	2	<5	<200	<500
9	2	0.46	<50	98	0.7	6.7	<10	9.4	<200	1	1	<20	26.0	5.0	<2	<5	<200	<500
10	3	2.20	150	17	0.4	27.0	<10	7.2	<200	3	1	<20	6.6	2.2	<2	<5	<200	<500
11	<2	3.00	<50	23	0.4	14.0	<10	9.2	<200	3	1	<20	4.8	1.5	<2	<5	<200	<500
12	2	1.80	130	<10	0.3	32.0	<10	7.2	<200	2	1	<20	5.1	1.8	<2	<5	<200	<500
13	20	1.90	110	11	0.2	31.0	<10	7.2	<200	2	1	<20	5.9	1.9	<2	<5	<200	<500
14	72	2.70	69	16	0.6	25.0	<10	8.5	<200	3	1	<20	4.9	1.4	<2	<5	<200	<500
15	<2	1.70	110	<10	0.2	33.0	<10	12.0	<200	4	2	<20	13.0	4.1	<2	<5	<200	<500
16	3	2.50	70	<10	0.3	25.0	<10	7.7	<200	2	1	<20	4.7	1.5	<2	<5	<200	<500
17	<2	<0.05	<20	<10	<0.2	<0.5	<10	0.3	<200	<1	<1	<20	<0.5	<0.5	<2	<5	<200	<500
18	<2	<0.05	<20	<10	0.2	0.9	<10	0.5	<200	<1	<1	<20	<0.5	0.9	<2	<5	<200	<500
19	<2	4.30	<20	56	0.7	7.4	<10	8.5	<200	4	<1	<20	8.5	2.7	2	<5	<200	<500
20	<2	4.40	<20	59	1.0	6.7	<10	8.7	<200	4	1	<20	8.8	3.4	<2	<5	<200	<500
21	<2	1.80	78	24	0.5	32.0	<10	8.7	<200	3	<1	<20	7.1	2.0	<2	<5	<200	<500
22	16	1.90	99	<10	0.6	36.0	<10	8.9	<200	2	1	<20	8.9	2.8	<2	<5	<200	<500
23	<2	1.90	120	18	<0.2	28.0	<10	7.2	<200	3	1	<20	6.3	2.2	<2	<5	<200	<500
27	3	1.90	<50	34	0.9	22.0	<10	8.8	<200	3	1	<20	7.5	2.1	<2	<5	<200	<500
28	65	2.10	190	13	0.5	33.0	<10	8.6	<200	3	1	<20	5.4	1.7	4	<5	<200	<500
29	3	3.30	<50	56	0.5	2.6	<10	6.8	<200	3	1	<20	10.0	4.6	<2	<5	<200	<500
30	4	3.50	<50	43	1.4	2.7	<10	6.8	<200	3	1	<20	10.0	4.6	3	<5	<200	<500
31	4	2.10	76	<10	1.2	33.0	<10	8.9	<200	2	<1	<20	11.0	3.6	<2	<5	240	<500
32	<1	1.40	320	8	0.2	33.4	<5	8.1	<100	2.7	0.6	<10	6.2	1.6	<1	3	<100	<200
33	<1	1.50	330	13	0.1	33.1	<5	8.2	<100	2.8	0.7	<10	6.5	1.7	<1	<2	<100	<200
34	<2	1.90	100	<10	0.7	29.0	<10	7.7	<200	3	1	<20	3.8	2.0	<2	<5	<200	<500
35	<2	1.60	78	<10	0.4	23.0	<10	9.1	<200	2	<1	<20	10.0	3.2	<2	<5	<200	<500
36	3	2.20	150	14	1.1	29.0	<10	6.2	<200	2	1	<20	3.0	1.3	<2	<5	<200	<500

Appendix B-Analytical results from Bondar-Clegg & Company Ltd., for samples from Coconino National Forest, Coconino and Yavapai Couties, Arizona.--Continued

Sample Number	Mo	Na	Ni	Rb	Sb	Sc	Se	Sm	Sn	Ta	Tb	Te	Th	U	W	Yb	Zn	Zr
37	<2	2.10	120	12	0.7	26.0	<10	6.0	<200	2	<1	<20	2.8	1.5	<2	<5	<200	<500
38	<2	2.20	130	<10	0.4	29.0	<10	6.3	<200	2	<1	<20	2.9	1.4	<2	<5	<200	<500
39	2	2.00	130	17	1.4	25.0	<10	5.6	<200	2	<1	<20	3.3	1.6	<2	<5	<200	<500
40	<2	2.60	<50	<10	<0.2	19.0	<10	6.4	<200	2	1	<20	4.1	1.5	<2	<5	<200	<500
41	4	2.20	99	<10	1.1	34.0	<10	12.0	<200	4	2	<20	15.0	5.2	<2	<5	290	<500
42	<2	2.30	110	13	<0.2	26.0	<10	6.9	<200	2	<1	<20	3.8	1.6	<2	<5	<200	<500
43	2	2.20	94	23	<0.2	24.0	<10	6.9	<200	2	1	<20	3.6	1.2	<2	<5	<200	<500
44	<2	2.60	58	12	<0.2	23.0	<10	6.9	<200	2	1	<20	2.2	0.7	<2	<5	210	<500
45	3	2.30	110	15	<0.2	25.0	<10	6.6	<200	2	<1	<20	3.3	1.2	<2	<5	<200	<500
46	<2	1.70	120	16	0.6	26.0	<10	7.0	<200	2	1	<20	5.8	1.7	<2	<5	<200	620
47	3	2.10	73	19	<0.2	21.0	<10	7.2	<200	3	1	<20	5.6	1.9	3	<5	230	<500
48	3	2.90	<50	17	<0.2	17.0	<10	11.0	<200	3	2	<20	3.6	1.4	<2	<5	<200	<500
49	<2	2.50	80	23	<0.2	22.0	<10	7.1	<200	2	<1	<20	3.2	0.9	<2	<5	<200	<500
51	3	2.40	<50	28	1.6	18.0	<10	9.1	<200	2	1	<20	3.4	1.2	<2	<5	<200	<500
52	<2	2.20	<50	25	0.9	18.0	<10	8.8	<200	2	1	<20	3.0	1.2	<2	<5	<200	<500
53	2	2.30	<50	20	2.7	19.0	<10	9.0	<200	2	1	<20	3.1	1.1	<2	<5	<200	<500
54	<2	2.60	<50	<10	1.5	20.0	<10	9.2	<200	2	1	<20	3.8	1.4	<2	<5	<200	<500
55	<2	1.80	100	34	0.2	19.0	<10	7.7	<200	2	1	<20	5.2	1.5	2	<5	<200	<500
56	<2	0.10	<20	21	0.4	0.9	<10	1.1	<200	<1	<1	<20	1.1	2.8	<2	<5	<200	<500
57	<2	0.13	<50	<10	<0.2	0.6	<10	0.3	<200	<1	<1	<20	<0.5	1.4	<2	<5	<200	<500
58	<2	0.13	<50	22	0.3	1.9	<10	1.4	<200	<1	<1	<20	2.1	2.6	<2	<5	<200	<500
60	<2	<0.05	<20	16	<0.2	0.8	<10	0.8	<200	<1	<1	<20	1.2	0.7	<2	<5	<200	<500
61	<2	0.13	<20	14	0.4	1.2	<10	1.5	<200	<1	<1	<20	1.2	5.4	<2	<5	<200	<500
63	<2	<0.05	<20	43	0.4	2.8	<10	2.4	<200	<1	<1	<20	2.8	0.9	<2	<5	<200	<500
64	<2	0.05	<20	48	0.3	1.5	<10	1.4	<200	<1	<1	<20	2.0	0.6	<2	<5	<200	<500
65	<2	<0.05	<20	23	0.2	1.1	<10	0.8	<200	<1	<1	<20	1.0	<0.5	<2	<5	<200	<500
66	<2	<0.05	<20	44	0.3	1.9	<10	1.5	<200	<1	<1	<20	2.3	1.0	<2	<5	<200	<500
67	2	<0.05	<20	11	0.8	0.8	<10	0.9	<200	<1	<1	<20	0.9	<0.5	<2	<5	<200	<500
68	<2	<0.05	<20	44	0.3	1.8	<10	1.4	<200	<1	<1	<20	2.0	0.9	<2	<5	<200	<500
69	<2	0.06	<20	91	0.6	5.3	<10	4.4	<200	<1	<1	<20	6.4	1.9	<2	<5	<200	<500
70	2	<0.05	<20	36	0.3	1.9	<10	1.5	<200	<1	<1	<20	2.0	1.6	<2	<5	<200	<500
71	<2	<0.05	<20	29	0.4	1.0	<10	1.0	<200	<1	<1	<20	1.4	0.7	<2	<5	<200	<500
72	<2	<0.05	<20	24	0.2	1.2	<10	1.0	<200	<1	<1	<20	1.4	1.0	<2	<5	<200	<500

Appendix B-Analytical results from Bondar-Clegg & Company Ltd., for samples from Coconino National Forest, Coconino and Yavapai Couties, Arizona.--Continued

Sample Number	Mo	Na	Ni	Rb	Sb	Sc	Se	Sm	Sn	Ta	Tb	Te	Th	U	W	Yb	Zn	Zr
73	13	<0.05	<20	19	0.3	1.6	<10	1.3	<200	<1	<1	<20	1.8	1.4	<2	<5	<200	610
74	2	<0.05	<20	41	0.4	2.5	<10	2.1	<200	<1	<1	<20	3.4	2.0	<2	<5	<200	740
75	<2	<0.05	<20	27	0.4	0.9	<10	1.0	<200	<1	<1	<20	1.0	<0.5	<2	<5	<200	<500
76	<2	<0.05	<20	40	0.3	1.3	<10	1.2	<200	<1	<1	<20	1.5	0.7	<2	<5	<200	<500
77	<2	<0.05	<20	41	0.3	1.6	<10	1.5	<200	<1	<1	<20	2.3	1.3	<2	<5	<200	<500
78	<2	<0.05	<20	<10	<0.2	1.0	<10	0.4	<200	<1	<1	<20	<0.5	<0.5	<2	<5	<200	<500
79	<2	0.11	<20	22	0.2	2.0	<10	1.2	<200	<1	<1	<20	2.0	0.6	<2	<5	<200	<500
80	<2	0.12	<20	34	0.2	2.3	<10	1.3	<200	<1	<1	<20	1.6	0.9	<2	<5	<200	<500
81	<2	<0.05	<20	<10	<0.2	0.6	<10	0.3	<200	<1	<1	<20	<0.5	<0.5	<2	<5	<200	<500
82	<2	0.06	<20	12	0.2	0.9	<10	0.7	<200	<1	<1	<20	1.3	0.9	<2	<5	<200	<500
83	<2	<0.05	<20	<10	<0.2	0.6	<10	0.3	<200	<1	<1	<20	0.7	1.0	<2	<5	<200	<500
84	<2	0.17	<20	57	0.4	4.0	<10	2.6	<200	<1	<1	<20	4.2	2.3	<2	<5	<200	<500
85	<2	0.07	<20	11	<0.2	1.3	<10	0.8	<200	<1	<1	<20	1.4	2.7	<2	<5	<200	<500
86	<2	0.07	<20	22	0.3	1.3	<10	0.8	<200	<1	<1	<20	1.4	1.9	<2	<5	<200	<500
87	<2	<0.05	<20	<10	<0.2	<0.5	<10	<0.2	<200	<1	<1	<20	<0.5	0.9	<2	<5	<200	<500
88	<2	0.17	<20	52	0.4	3.8	<10	2.4	<200	<1	<1	<20	4.6	4.0	<2	<5	<200	<500
89	<2	0.08	<20	<10	<0.2	1.1	<10	0.7	<200	<1	<1	<20	1.5	1.0	<2	<5	<200	<500
90	<2	<0.05	<20	<10	<0.2	0.6	<10	0.3	<200	<1	<1	<20	0.8	0.9	<2	<5	<200	<500
91	<2	<0.05	<20	<10	<0.2	0.6	<10	0.3	<200	<1	<1	<20	0.5	1.3	<2	<5	<200	<500
92	<2	0.14	<20	22	0.5	3.3	<10	1.8	<200	<1	<1	<20	3.2	3.0	<2	<5	<200	<500
93	<2	0.27	<20	61	0.5	4.7	<10	3.1	<200	1	<1	<20	5.6	2.2	<2	<5	<200	<500
94	<2	0.22	<20	59	0.7	4.9	<10	2.6	<200	<1	<1	<20	4.6	2.0	<2	<5	<200	<500
95	<2	0.31	26	65	0.6	6.0	<10	4.0	<200	<1	<1	<20	7.7	8.0	<2	<5	<200	<500
96	<2	0.14	<20	47	0.4	3.4	<10	2.6	<200	<1	<1	<20	4.2	3.4	<2	<5	<200	<500
97	<2	0.19	<20	37	0.3	3.2	<10	2.3	<200	<1	<1	<20	3.3	1.7	<2	<5	<200	<500
98	1	0.10	<20	24	0.4	1.6	<5	1.1	<100	<0.5	<0.5	<10	2.1	8.6	<1	<2	<100	<200
99	<1	0.05	<20	14	0.2	0.8	<5	0.2	<100	<0.5	<0.5	<10	1.2	15.0	<1	<2	<100	<200
100	<1	0.05	<20	13	<0.1	0.9	<5	0.5	<100	<0.5	<0.5	<10	1.3	5.7	<1	<2	<100	<200
101	2	0.10	<20	29	0.2	2.4	<5	1.4	<100	<0.5	<0.5	<10	2.4	11.0	<1	<2	<100	<200
102	<1	0.17	<20	39	0.4	3.6	<5	3.1	<100	0.5	0.6	<10	3.2	1.5	<1	<2	<100	<200
103	3	0.05	<20	20	2.2	2.7	<5	2.1	<100	<0.5	<0.5	<10	1.8	1.7	<1	<2	<100	<200
104	<1	0.13	<20	23	1.3	2.1	7	0.1	<100	<0.5	<0.5	<10	2.1	55.7	<1	<2	<100	<200
105	<1	0.14	<20	32	0.3	2.3	<5	1.4	<100	<0.5	<0.5	<10	2.5	8.9	<1	<2	<100	<200

Appendix B-Analytical results from Bondar-Clegg & Company Ltd., for samples from Coconino National Forest, Coconino and Yavapai Couties, Arizona.--Continued

Sample Number	Mo	Na	Ni	Rb	Sb	Sc	Se	Sm	Sn	Ta	Tb	Te	Th	U	W	Yb	Zn	Zr
106	1	0.11	<20	41	1.0	3.6	<5	2.1	<100	<0.5	<0.5	<10	3.6	14.0	<1	<2	<100	420
107	<1	0.12	<20	33	0.5	2.8	<5	2.3	<100	<0.5	<0.5	<10	2.8	8.3	<1	<2	<100	<200
108	<1	0.17	<20	72	0.5	5.9	<5	4.1	<100	0.6	0.6	<10	6.2	2.9	1	2	<100	270
109	<1	0.33	<20	77	0.5	5.9	<5	3.8	<100	0.8	0.6	<10	6.2	22.1	<1	<2	<100	310
110	<3	0.25	<20	30	0.3	2.2	<5	<4.0	200	<0.5	<0.5	<10	3.3	126.0	1	<2	<100	<200
111	<3	0.15	<20	18	0.1	1.1	<5	<4.1	160	<0.5	<0.5	<10	1.9	133.0	<1	<2	<100	<200
112	<2	<0.05	<50	<10	0.2	<0.5	<10	<0.2	<200	<1	<1	<20	<0.5	26.0	<2	<5	<200	<500
113	<2	0.11	<50	31	0.4	3.1	<10	1.6	<200	<1	<1	<20	3.1	7.9	<2	<5	<200	<500
114	<1	0.25	<20	84	1.3	6.6	<5	3.5	<100	0.8	<0.5	<10	6.7	31.3	1	<2	<100	<200
115	<2	0.10	<20	25	0.3	2.7	<10	1.8	<200	<1	<1	<20	2.6	1.4	<2	<5	<200	<500
116	<2	0.17	<20	47	0.3	2.9	<10	1.8	<200	<1	<1	<20	3.1	28.0	<2	<5	<200	<500
117	<2	0.18	<20	47	0.3	3.6	<10	2.1	<200	<1	<1	<20	4.0	4.6	<2	<5	<200	<500
118	<2	0.08	<20	17	0.2	1.3	<10	<1.7	<200	<1	<1	<20	1.6	71.5	<2	<5	<200	<500
119	<2	0.14	<20	29	0.3	2.4	<10	1.3	<200	<1	<1	<20	2.7	11.0	<2	<5	<200	<500
120	<2	0.08	<20	20	<0.2	1.6	<10	1.2	<200	<1	<1	<20	1.5	8.6	<2	<5	<200	<500
121	<2	0.26	22	49	0.5	4.4	<10	2.5	<200	<1	<1	<20	4.8	7.3	<2	<5	<200	<500
122	<2	0.20	<20	17	0.4	2.2	<10	1.5	<200	<1	<1	<20	3.0	2.3	<2	<5	<200	<500
123	<2	0.05	<20	<10	<0.2	0.6	<10	0.4	<200	<1	<1	<20	0.7	3.4	<2	<5	<200	<500
124	<2	0.18	<50	24	1.3	2.8	<10	0.4	<200	<1	<1	<20	3.0	23.0	<2	<5	<200	<500
125	<2	0.08	<50	17	0.2	1.7	<10	0.6	<200	<1	<1	<20	1.6	5.8	<2	<5	<200	<500
126	<2	0.07	<20	27	0.2	1.4	<10	0.8	<200	<1	<1	<20	1.4	9.2	<2	<5	<200	<500
127	<2	0.13	<20	22	0.4	1.3	<10	<1.8	<200	<1	<1	<20	1.3	75.4	<2	<5	<200	<500
128	<2	0.09	<20	16	<0.2	0.9	<10	<0.2	<200	<1	<1	<20	1.0	40.0	<2	<5	<200	<500
129	<2	0.22	<20	48	0.3	3.5	<10	1.9	<200	<1	<1	<20	3.4	18.0	<2	<5	<200	<500
130	<2	0.09	<50	25	0.9	3.1	<10	<0.2	<200	<1	<1	<20	2.4	24.0	<2	<5	<200	<500
131	<2	0.09	<20	17	0.2	1.0	<10	0.7	<200	<1	<1	<20	1.6	13.0	<2	<5	<200	<500
132	<2	0.08	<20	15	<0.2	1.3	<10	0.8	<200	<1	<1	<20	1.5	9.0	<2	<5	<200	<500
133	<2	0.09	<50	12	3.9	1.7	<10	<0.2	<200	<1	<1	<20	1.6	25.0	<2	<5	<200	<500
134	<2	0.07	<20	37	<0.2	2.1	<10	0.9	<200	<1	<1	<20	2.0	49.0	<2	<5	<200	<500
135	<2	0.12	<20	40	0.2	1.7	<10	0.8	<200	<1	<1	<20	1.9	48.0	<2	<5	<200	<500
136	<2	<0.05	<20	<10	<0.2	0.6	<10	<0.8	<200	<1	<1	<20	0.6	35.0	<2	<5	<200	<500
137	<4	0.18	<50	25	0.3	1.9	<10	<3.8	<200	<1	<1	<20	1.9	158.0	<2	<5	<200	<500
138	<2	0.05	<50	12	7.0	1.2	<10	<0.2	<200	<1	<1	<20	1.5	22.0	<2	<5	<200	<500
139	<2	0.06	<20	28	0.3	2.0	<10	1.2	<200	<1	<1	<20	2.1	3.8	<2	<5	<200	<500

Appendix B-Analytical results from Bondar-Clegg & Company Ltd., for samples from Coconino National Forest, Coconino and Yavapai Couties, Arizona.--Continued

Sample Number	Mo	Na	Ni	Rb	Sb	Sc	Se	Sm	Sn	Ta	Tb	Te	Th	U	W	Yb	Zn	Zr
140	<2	<0.05	<20	14	<0.2	1.3	<10	0.9	<200	<1	<1	<20	1.4	6.8	<2	<5	<200	<500
141	<2	0.16	<20	58	0.3	3.2	<10	2.1	<200	<1	<1	<20	3.4	4.9	<2	<5	<200	<500
142	<2	0.20	<20	82	0.3	2.9	<10	2.1	<200	<1	<1	<20	4.5	49.0	<2	<5	<200	<500
143	<2	0.38	<20	34	0.2	1.7	<10	0.6	<200	<1	<1	<20	2.0	61.9	<2	<5	<200	<500
144	<2	0.12	<20	13	<0.2	1.2	<10	0.7	<200	<1	<1	<20	1.4	7.9	<2	<5	<200	<500
145	<2	0.13	<20	27	<0.2	1.5	<10	0.7	<200	<1	<1	<20	1.9	52.7	<2	<5	<200	<500
146	<2	0.13	<20	28	0.2	1.4	<10	1.0	<200	<1	<1	<20	1.7	3.5	<2	<5	<200	<500
147	<2	0.17	<20	37	0.4	2.3	<10	1.5	<200	<1	<1	<20	3.0	21.0	<2	<5	<200	<500
148	<2	0.16	<20	29	0.2	1.6	<10	1.0	<200	<1	<1	<20	2.1	8.6	<2	<5	<200	<500
149	<2	0.18	<20	57	0.3	2.2	<10	0.8	<200	<1	<1	<20	2.9	102.0	<2	<5	<200	<500
150	<2	0.15	<20	42	0.4	2.9	<10	1.7	<200	<1	<1	<20	3.2	10.0	<2	<5	<200	<500
151	<2	0.09	<20	31	0.3	2.6	<10	1.7	<200	<1	<1	<20	2.4	2.9	<2	<5	<200	<500
152	<2	0.16	21	58	0.6	3.5	<10	2.0	<200	<1	<1	<20	4.3	15.0	<2	<5	<200	<500
153	<2	0.11	<20	49	0.2	3.2	<10	2.6	<200	<1	<1	<20	3.7	1.9	<2	<5	<200	<500
154	<2	0.20	<20	34	0.4	2.0	<10	0.7	<200	<1	<1	<20	2.0	55.4	<2	<5	<200	<500
155	<2	0.13	<20	60	0.3	3.6	<10	2.6	<200	<1	<1	<20	4.2	2.2	<2	<5	<200	<500
156	<2	0.15	<20	49	0.4	4.0	<10	2.4	<200	<1	<1	<20	4.3	4.4	<2	<5	<200	<500
157	<2	<0.05	<20	16	0.6	1.3	<10	0.8	<200	<1	<1	<20	1.4	12.0	<2	<5	<200	<500
158	<2	0.18	<20	58	0.5	4.5	<10	2.6	<200	<1	<1	<20	4.9	2.7	<2	<5	<200	540
159	<2	0.14	<20	17	0.2	1.3	<10	0.7	<200	<1	<1	<20	1.7	18.0	<2	<5	<200	<500
160	<2	0.10	<20	23	0.6	1.6	<10	0.9	<200	<1	<1	<20	1.8	22.0	<2	<5	<200	<500
161	<2	0.10	<20	31	<0.2	1.8	<10	1.2	<200	<1	<1	<20	2.0	4.3	<2	<5	<200	<500
162	<2	0.13	<20	41	0.4	2.8	<10	2.1	<200	<1	<1	<20	3.4	2.3	<2	<5	<200	<500
163	<2	0.10	<20	35	<0.2	2.2	<10	2.0	<200	<1	<1	<20	2.5	2.0	<2	<5	<200	<500
164	<2	0.24	<20	73	0.4	5.5	<10	2.9	<200	<1	<1	<20	5.0	2.8	<2	<5	<200	<500
165	<2	0.13	<20	35	0.3	3.0	<10	2.0	<200	<1	<1	<20	3.0	1.6	<2	<5	<200	<500
166	<2	0.16	<20	15	0.2	1.4	<10	0.8	<200	<1	<1	<20	1.5	3.7	<2	<5	<200	<500
167	<2	0.15	<20	25	0.3	1.6	<10	1.0	<200	<1	<1	<20	2.0	6.2	<2	<5	<200	<500
168	<2	0.10	<20	<10	0.2	1.7	<10	0.9	<200	<1	<1	<20	1.5	4.4	<2	<5	<200	<500
169	<2	0.10	<20	38	0.3	2.5	<10	1.7	<200	<1	<1	<20	2.8	1.5	<2	<5	<200	<500
170	<2	0.21	<20	26	0.4	2.1	<10	1.3	<200	<1	<1	<20	3.0	6.3	<2	<5	<200	<500
171	<2	0.34	<20	<10	0.2	1.5	<10	0.7	<200	<1	<1	<20	1.6	2.9	<2	<5	<200	<500
172	<2	0.09	<20	30	0.4	2.3	<10	1.3	<200	<1	<1	<20	2.4	1.8	<2	<5	<200	<500

Appendix B-Analytical results from Bondar-Clegg & Company Ltd., for samples from Coconino National Forest, Coconino and Yavapai Couties, Arizona.--Continued

Sample Number	Mo	Na	Ni	Rb	Sb	Sc	Se	Sm	Sn	Ta	Tb	Te	Th	U	W	Yb	Zn	Zr
173	<2	0.20	<20	43	0.5	3.8	<10	2.4	<200	<1	<1	<20	4.4	3.0	<2	<5	<200	<500
174	<2	0.19	<20	44	0.5	2.8	<10	2.0	<200	<1	<1	<20	3.2	2.1	<2	<5	<200	<500
175	<2	0.13	<20	29	0.3	1.8	<10	1.3	<200	<1	<1	<20	2.2	1.4	<2	<5	<200	<500
176	<2	0.13	<20	41	0.6	1.6	<10	1.6	<200	<1	<1	<20	2.9	1.6	<2	<5	<200	<500
177	<2	0.11	<20	37	0.3	2.8	<10	2.2	<200	<1	<1	<20	3.5	1.4	<2	<5	<200	<500
178	<2	0.08	<20	31	0.3	2.5	<10	1.9	<200	<1	<1	<20	3.4	1.5	<2	<5	<200	<500
179	<2	0.08	<20	55	0.4	3.5	<10	3.1	<200	<1	<1	<20	4.8	1.5	<2	<5	<200	<500
180	<2	<0.05	<50	<10	<0.2	<0.5	<10	<0.2	<200	<1	<1	<20	<0.5	1.0	<2	<5	<200	<500
181	<2	<0.05	<50	<10	0.3	<0.5	<10	<0.2	<200	<1	<1	<20	<0.5	6.4	<2	<5	<200	<500
183	<2	<0.05	<20	<10	<0.2	<0.5	<10	0.3	<200	<1	<1	<20	<0.5	0.6	<2	<5	<200	<500
188	<2	0.34	<20	38	0.3	2.5	<10	1.4	<200	<1	<1	<20	2.6	9.4	<2	<5	<200	<500
189	<2	1.60	55	41	<0.2	14.0	<10	4.8	<200	2	<1	<20	5.8	1.7	<2	<5	<200	<500
190	<2	<0.05	<50	13	<0.2	0.7	<10	0.7	<200	<1	<1	<20	1.1	<0.5	<2	<5	<200	<500
191	<2	<0.05	<50	18	0.3	1.6	<10	1.0	<200	<1	<1	<20	2.0	1.2	<2	<5	<200	580
192	<2	2.30	75	<10	<0.2	28.0	<10	11.0	<200	2	1	<20	11.0	2.2	<2	<5	<200	<500
193	677	0.06	75	59	4.0	2.9	<10	2.1	<400	<1	<1	<20	2.2	8.9	9	9	960	<500
194	1730	0.06	63	110	3.0	4.2	<10	1.2	<200	<1	<1	<20	0.5	8.3	19	7	570	<500
195	1770	<0.05	190	120	1.3	2.7	<10	3.6	<200	<1	<1	<20	1.3	3.8	3	7	680	<500
196	919	0.09	110	38	2.3	3.4	<10	3.7	<200	<1	<1	<20	2.2	2.1	10	6	330	<500
197	1140	0.06	97	51	2.8	2.1	<10	5.0	<200	<1	<1	<20	2.0	3.6	7	8	<200	<500
198	1980	0.07	140	58	6.0	3.7	<10	6.3	<200	<1	1	<20	1.6	4.5	25	12	560	<500
199	93	<0.05	59	<10	8.7	7.9	<10	3.8	<200	<1	<1	<20	4.1	1.3	24	8	820	<500
200	130	<0.05	50	24	6.0	11.0	<10	4.5	<200	<1	<1	<20	2.9	2.2	31	10	700	<500
201	3	0.07	<20	77	0.5	6.0	<10	5.0	<200	<1	<1	<20	7.0	2.3	<2	<5	<200	510
202	<2	<0.05	<20	<10	<0.2	0.7	<10	0.4	<200	<1	<1	<20	<0.5	0.6	<2	<5	<200	<500
203	1440	0.05	340	56	2.5	5.3	<10	8.7	<200	<1	<1	<20	1.8	6.3	72	14	510	<500
204	1730	<0.05	1000	140	3.1	6.4	<10	4.8	<200	<1	2	<20	1.5	7.2	24	<5	660	600
205	2750	0.19	130	90	8.4	1.7	<10	7.0	<200	<1	1	<20	2.8	1.2	15	9	280	<500
206	6	<0.05	<20	11	<0.2	1.1	<10	0.9	<200	<1	<1	<20	1.1	<0.5	2	<5	<200	<500
207	10	0.08	<20	21	0.5	1.5	<10	2.1	<200	<1	<1	<20	1.6	5.2	2	<5	<200	<500
208	170	<0.05	<43	<32	19.0	18.0	<10	3.4	<570	<1	<1	<69	1.6	3.4	1410	10	730	<500
209	3	2.40	210	38	0.7	31.0	<10	8.0	<200	5	1	<20	5.9	1.6	<2	<5	<200	<500
210	<2	0.54	190	<10	<0.2	38.0	<10	8.9	<200	4	1	<20	13.0	1.6	<2	<5	<200	<500

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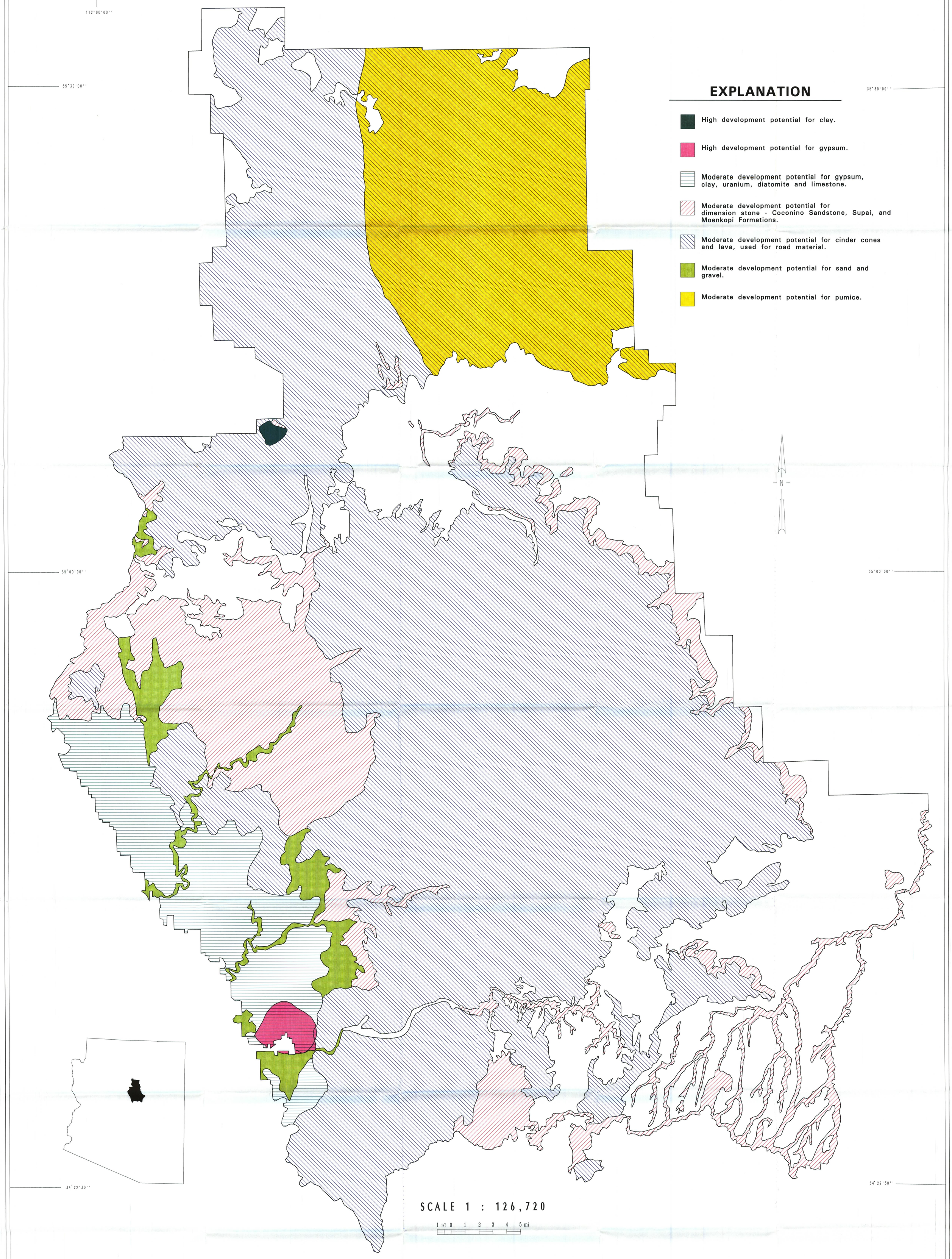
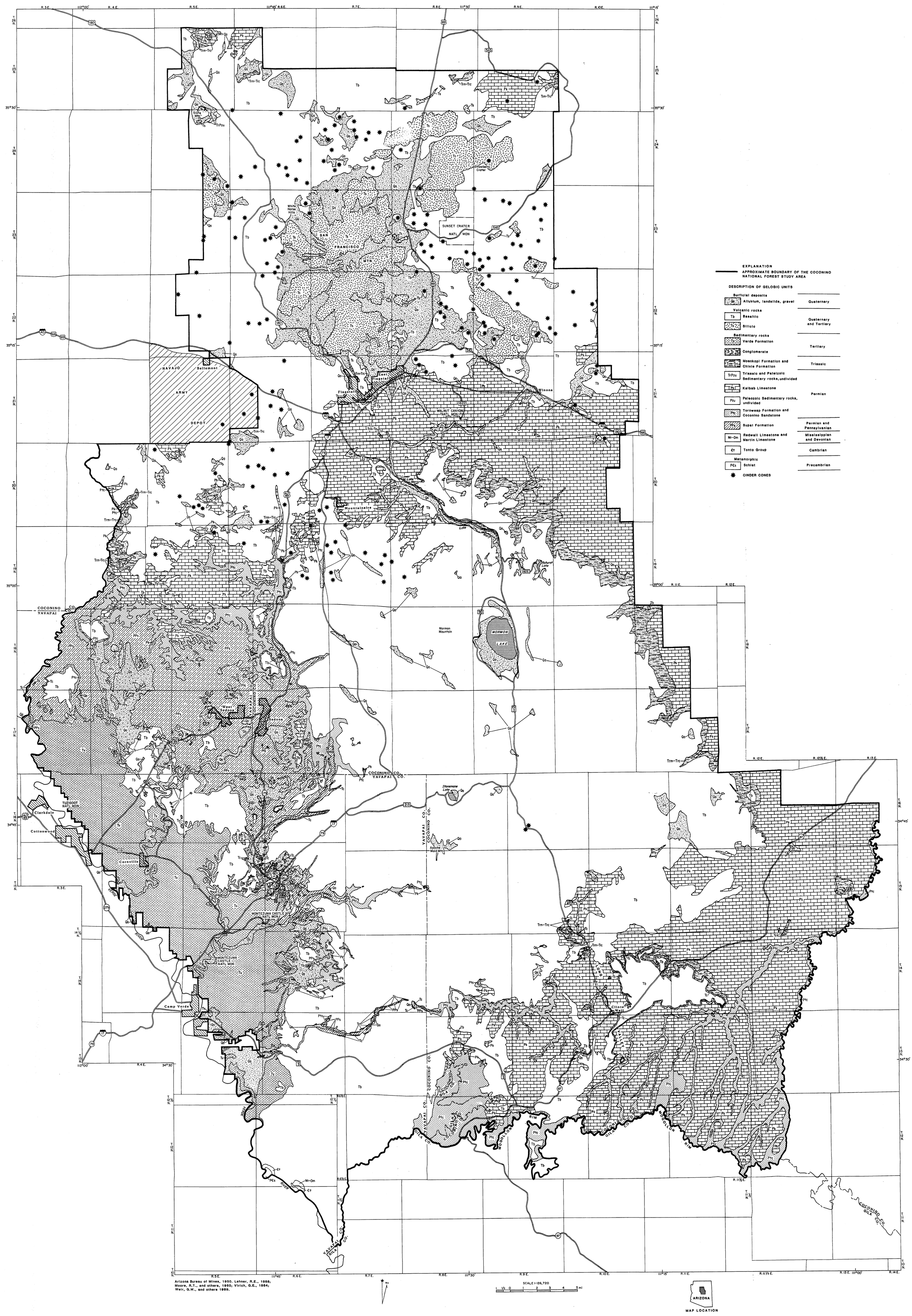


MINERAL RESOURCE MAP FOR COCONINO NATIONAL FOREST, ARIZONA



GEOLOGIC MAP OF THE COCONINO NATIONAL FOREST, COCONINO, GILA AND YAPAPAI COUNTIES, ARIZONA

COMPILED BY

MICHAEL E. LANE, U.S. BUREAU OF MINES

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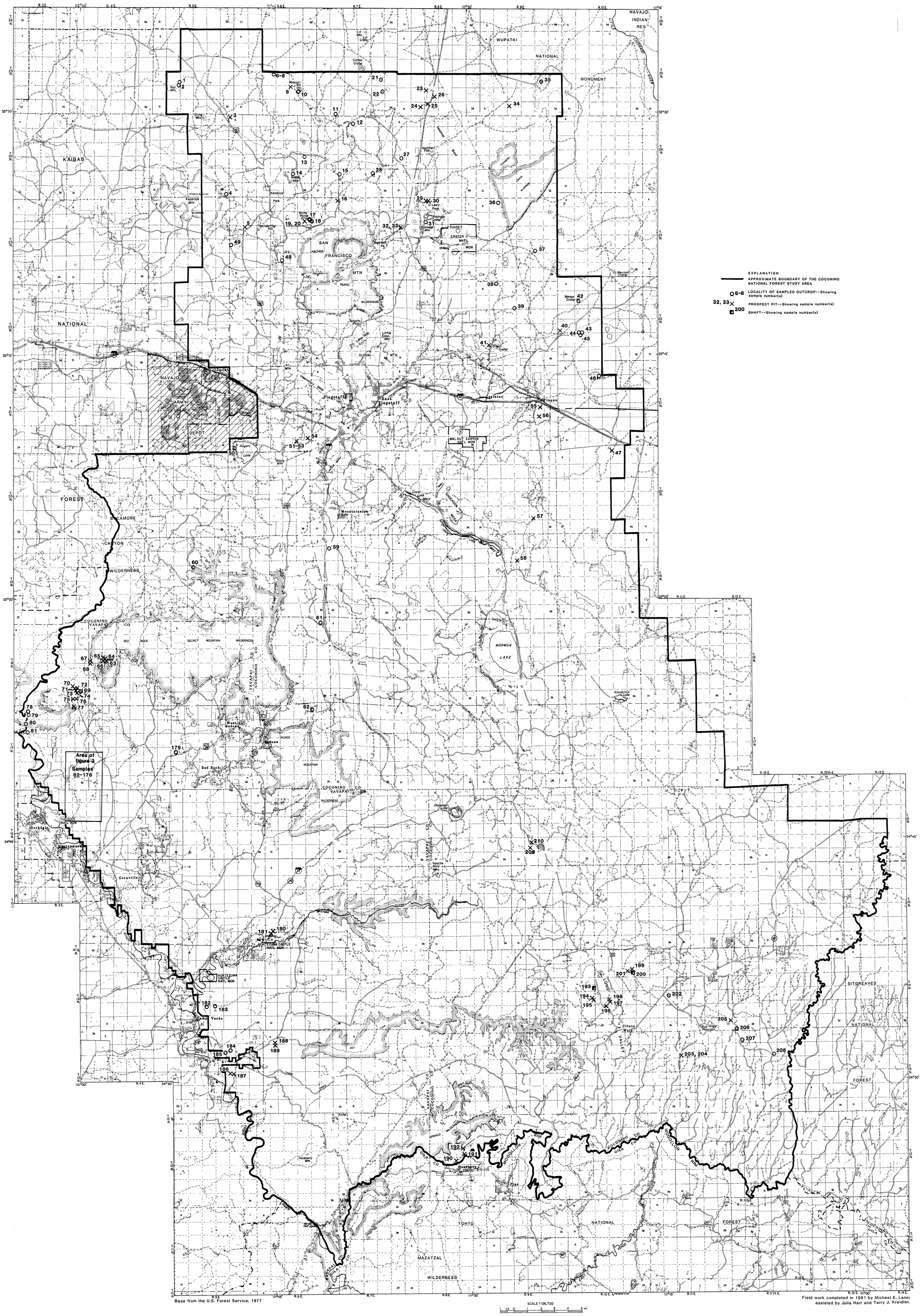

SAMPLE LOCALITIES IN THE COCONINO NATIONAL FOREST, ARIZONA

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